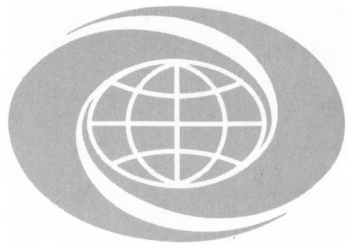

The World Book Encyclopedia

S-Sn Volume 17

Field Enterprises Educational Corporation
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The World Book Encyclopedia

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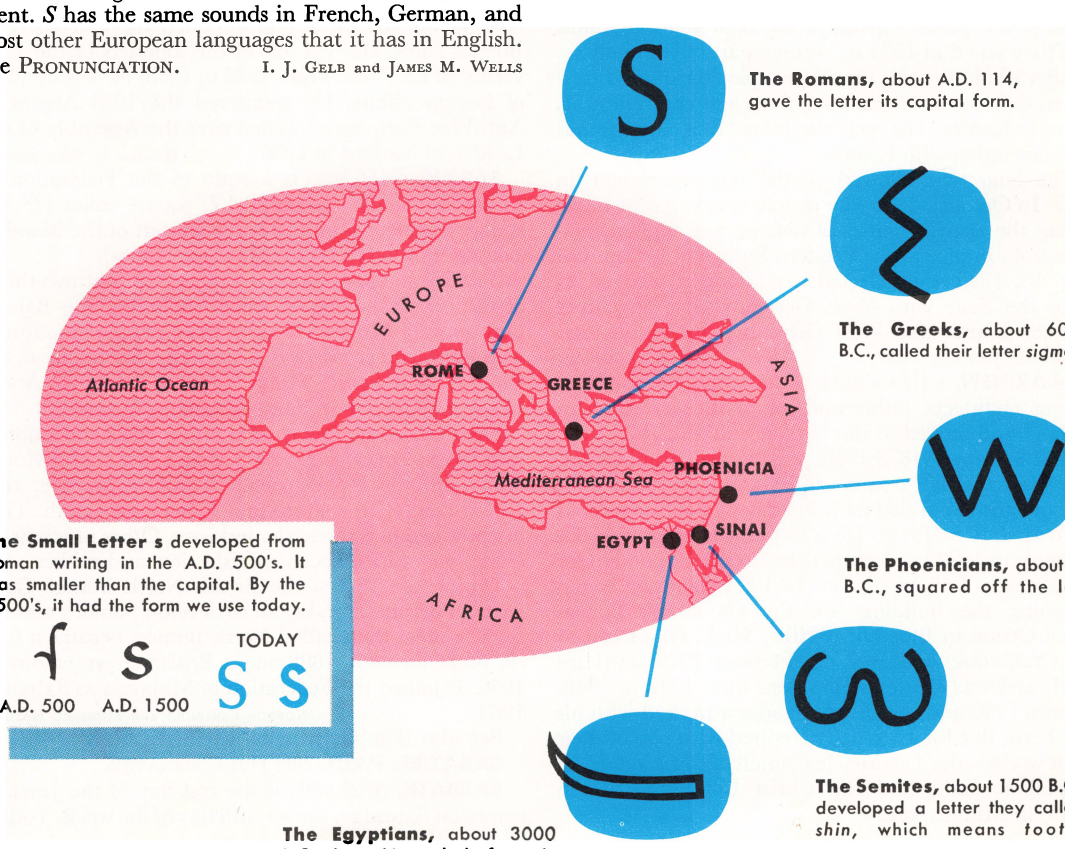
S s is the 19th letter in our alphabet. It was also a letter in the alphabet of the ancient Semites, who once lived in Syria and Palestine. They called the letter *shin*, meaning tooth. The Phoenicians took over the Semitic letter and gave it a more regular shape, and the Greeks turned it on its side. See ALPHABET.

Uses. *S* or *s* is about the eighth most frequently used letter in books, newspapers, and other printed material in English. When used on a report card, *S* may mean *superior* or *satisfactory*. As a geographic abbreviation, it stands for *south* or *southern*. As an abbreviation in titles, *S* often means *society*, *state*, or *school*. In music, *s* is used as an abbreviation for *soprano* or *solo*. It stands for the element *sulfur* in chemistry, and for *singular* number in grammars and dictionaries. It is also used as an abbreviation for *size* in advertisements and catalogues.

Pronunciation. *S* has two common sounds in English. It can have a hissing sound, as in *sat*. A person produces this sound by forcing his breath through his open lips with his tongue below the lower teethridge and his vocal cords relaxed. *S* can be pronounced as *z* in the middle or at the end of a word (*season*, *has*). This sound is produced in much the same way, but with the vocal cords vibrating. In such words as *aisle* or *debris*, the *s* is silent. *S* has the same sounds in French, German, and most other European languages that it has in English. See PRONUNCIATION.

I. J. GELB and JAMES M. WELLS

The 19th letter took its shape from a letter used by the ancient Semites. Its sound came from their name for the letter, *shin*, their word for *tooth*.



SAADI, *sah DEE* (1184?-1291), was a famous Persian writer and poet. Under the protection of his patron, the ruler of Fars, he studied in Baghdad, and won fame by his writings. The Mongols deposed his patron in 1226, and Saadi became a wanderer. He finally went to Jerusalem, where he lived as a hermit until he was captured by some Frankish crusaders. He was rescued and returned home. Most important of his 22 works are *Bostan* (Orchard) and the *Gulistan* (Rose Garden), in prose and verse. Saadi's works were the first Persian literature to be introduced into Europe. Moslems honor Saadi as a saint. He was born in Shiraz. WALTER J. FISCHEL

SAAR, *zahr*, is a state in West Germany on the Franco-German border. Its population is 1,127,400. It is named after the Saar River, which flows through the area. The region is also called the Saar Territory, or the Saar Basin. It covers 991 square miles (2,567 square kilometers) in the western Rhineland near Lorraine and Luxembourg (see GERMANY [political map]). The Saar is valuable for its many coal mines and steel plants. Its capital is Saarbrücken.

Before World War I, the Saar belonged to Germany. After the war, France wanted to annex the Saar in payment for war damages. The Treaty of Versailles gave France the use of the Saar coal mines for 15 years in payment for French losses.

The League of Nations governed the Saar during the French occupation. The governing body included one Frenchman, one German, and three persons of other nationalities. Germany protested against this, and in 1930 the League ordered an end to the allied control. Most of the persons living in the Saar were Germans and they voted in 1935 to become part of Germany.

After World War II, France occupied the Saar, directing its defense and foreign relations and controlling its heavy industries. The Saar also joined in a customs and currency union with France.

The Saar was allowed partial self-government in 1947. In October, 1955, the people voted against transferring the responsibilities of defense and foreign relations from France to the Western European Union. On Dec. 18, 1955, they elected a parliament pledged to unite the Saar with West Germany. By agreement between France and West Germany, this union took place on Jan. 1, 1957. FRANK O. AHNERT

SAARINEN, *SAH rih nehn*, is the family name of two famous architects, father and son. Both were born in Finland and moved to the United States in 1923.

Eliel Saarinen (1873-1950) was born in Rantasalmi, near Varhaus. He became internationally famous for the bold and simplified traditional design of his Helsinki railroad station (1914). He also gained recognition for his entry in 1922 in a competition to select a design for the Chicago Tribune Tower. In 1925, Saarinen began designing the buildings for the Cranbrook Educational Center in Bloomfield Hills, Mich. He taught at the Cranbrook Academy of Art from 1929 until his death and was academy president from 1932 to 1948.

From 1936 until his death, Saarinen worked with his son, Eero. But Eliel is chiefly credited with two of their finest works—the Tabernacle Church of Christ (1942) in Columbus, Ind., and the Christ Lutheran Church (1949) in Minneapolis.

Eero Saarinen (1910-1961) was born in Kyrkslätt, near Helsinki. In 1948, his design of a giant stainless steel arch won a competition for a memorial in St. Louis. Saarinen was most noted for his daring use of form. He became famous for his boxlike steel-frame buildings for the General Motors Technical Center (1955) in Warren, Mich. His Kresge Auditorium (1955) at the Massachusetts Institute of Technology (M.I.T.) is a concrete dome with only three points of support. His M.I.T. chapel (1955) is a small brick cylinder. Saarinen's Trans World Airlines Terminal (1962) at Kennedy International Airport in New York City uses winglike forms. His design for Dulles International Airport (1962) near Washington, D.C., is noted for its passenger lounges, which can be driven to the airplane. See also SAINT LOUIS (picture: The Gateway Arch); ARCHITECTURE (Today [picture]); INTERIOR DECORATION (picture: Form in Interior Design). STANFORD ANDERSON

Knoll Associates, Inc.

Eero Saarinen

SAAVEDRA LAMAS, *SAH ah VAY thrah LAH mahs*, **CARLOS** (1878-1959), received the Nobel peace prize in 1936. He served Argentina at the Montevideo and Buenos Aires conferences in 1933 and 1936, and figured in the settlement of the dispute between Paraguay and Bolivia over the Chaco region. Saavedra Lamas was born in Buenos Aires, and attended the University of Buenos Aires. He was one of the founders of the University of La Plata. From 1932 to 1938, he was minister of foreign affairs. He sponsored the 1933 Argentine Anti-War Pact, and presided over the Assembly of the League of Nations in 1936. DONALD E. WORCHESTER

SABAH, *SAH bah*, is a state of the Federation of Malaysia. Sabah covers 28,460 square miles (73,711 square kilometers) on the northern part of the island of Borneo. For location, see MALAYSIA (map).

Sabah has a population of 808,000. About two-thirds of the people belong to tribes, including the Bajaus, Dusuns, and Muruts. Most of these people are farmers who grow food crops for their own use. Sabah has many Chinese and some Malays and Europeans. About 42,000 people live in Kota Kinabalu, the capital.

Sabah has a narrow coastal plain. Hills and tropical rain forests cover about 80 per cent of Sabah. Mount Kinabalu, the highest peak in Southeast Asia, rises 13,455 feet (4,101 meters) in northwestern Sabah. Timber production is the major industry. Other products include *copra* (dried coconut), fish, rice, and rubber.

During the 1880's, the British North Borneo Company, a private firm, began to develop Sabah's resources. The area, then called North Borneo, became a British protectorate in 1888 and a British crown colony in 1946. It joined the Federation of Malaysia as Sabah in 1963. NORTON GINSBURG and MICHAEL KASSERA

See also BORNEO; MALAYSIA; SANDAKAN.

SABATIER, PAUL. See HYDROGENATION.

SABBATH, *SAB uhth*, is the rest day of the Jews. It comes on Saturday, the seventh day of the week. Today,

Christians also use the word *Sabbath* for their Sunday.

In ancient Hebrew history, the Sabbath was a joyous, holy day. People stopped working, visited the temple, and offered a double number of sacrifices. One of the Ten Commandments (Exod. 20:8-11) is about observing the Sabbath. After the Babylonian exile, Sabbath observance became very strict. The Jews suffered many losses and insults rather than break the Sabbath laws. In the Oral Law, 39 kinds of labor were forbidden. These included bearing burdens, gathering sticks, lighting fires, and traveling more than a Sabbath day's journey, a distance of about 1 mile (1.6 kilometers).

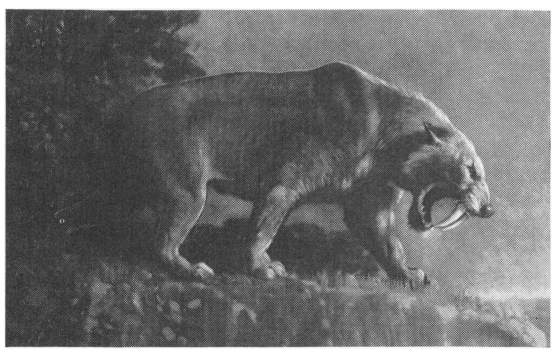
Many Jews today still keep strict Sabbath regulations. Their Sabbath lasts from sunset Friday evening until sunset Saturday. Christians have generally adopted Sunday as the Sabbath because they believe Jesus Christ rose from the dead on Sunday (see SUNDAY). But the Seventh-day Adventists, a Christian sect, observes Saturday as the Sabbath. LOUIS L. MANN

SABENA. See HELICOPTER (Helicopter Airlines).

SABER. See FENCING.

SABER-TOOTHED CAT, or SABER-TOOTHED TIGER, was a catlike prehistoric animal. It was one of many catlike species that had enlarged *canine teeth* (the long, pointed teeth near the front of the mouth). The teeth were shaped like *sabers* (curved swords), and were about 8 inches (20 centimeters) long. The first saber-toothed cats lived about 40 million years ago. They became extinct about 12,000 years ago. Fossils have been found in Africa, Europe, and North and South America. The cats were probably as heavy as today's tigers. They probably ate thick-skinned animals, including elephants, mastodons, and ground sloths.

Scientific Classification. Saber-toothed cats were in the cat family, *Felidae*. The most common American species was *Smilodon californicus*. SAMUEL PAUL WELLES



Painting by Charles R. Knight, from the American Museum of Natural History

The Saber-Toothed Cat Had Two Long, Fanglike Teeth.

SABIN, ALBERT B. (1906-), an American virologist, developed a polio vaccine that can be taken by mouth (see POLIOMYELITIS). It was approved for use in the United States in 1961. Born in Bialystok, Russia, Sabin was graduated from the New York University College of Medicine in 1931. He joined the staff of University of Cincinnati College of Medicine in 1939. In 1963, Sabin began a study of viruses and human cells to find out how normal cells become cancerous.

SABIN, FLORENCE RENA (1871-1953), was an American scientist. Born in Central City, Colo., she studied and taught at Johns Hopkins University School of Medicine. From 1925 until 1938 she worked at the Rockefeller Institute for Medical Research (now Rockefeller University). After retirement, she became famous for her public health work. Her statue represents Colorado in the U.S. Capitol's Statuary Hall.

SABINE, *SAY byn*, was a member of an ancient Italian tribe. The Sabines lived northeast of Rome, and were among the ancestors of the Romans. The Sabines are famous for a legend told about them. According to the legend, no women lived in Rome when Romulus founded the city. Romulus asked neighboring cities to allow Romans to choose wives from among their women. When the cities refused, Romulus invited all the surrounding people to attend a great festival. During the festival games, the Romans carried off young Sabine women by force. The Sabines went to war with the Romans, but the women persuaded the two tribes to stop fighting and unite as one nation. HERBERT M. HOWE

SABINE RIVER is an important waterway of Texas and Louisiana. It forms two-thirds of the boundary between these states. It rises in Hunt County in northeast Texas, and flows southeast for about half of its 360-mile (579-kilometer) course before turning south between Texas and Louisiana. The river empties into Sabine Lake, which flows into the Gulf of Mexico. For location, see LOUISIANA (physical map). H. BAILEY CARROLL

SABLE, *SAY buhl*, is a small animal in the weasel family. It has the most valuable pelt of all weasels. It lives in Siberia, and is closely related to the North American *pine marten*, or *American sable* (see MARTEN). The sable is about 20 inches (51 centimeters) long, including its 5-inch (13-centimeter) tail. Its fur ranges from dark brown to almost black, with a grayish-yellow patch on the throat. The coat does not change to white in winter, as do those of some animals. In Europe, sable is used in the robes of rulers. Furriers make it into expensive clothing (see FUR).

Sovfoto

Sables are bred and raised on sable farms for their luxurious fur. The animals live in Siberia but have become rare.

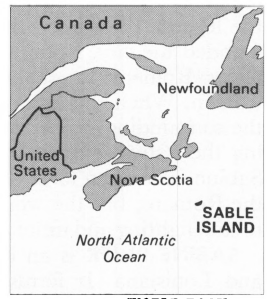
Sables range from eastern Russia across Siberia to Hokkaido, in northern Japan. Because of the demand for the fur, trappers have killed off the animals in the western and southwestern portions of the Russian range. Sables are rare almost everywhere. Russia has closed the trapping season several times, and has experimented successfully with raising sables.

Scientific Classification. The Siberian sable belongs to the family *Mustelidae*. It is classified as genus *Martes*, species *M. zibellina*. E. LENDELL COCKRUM

SABLE, JEAN BAPTISTE POINT DU. See DU SABLE, JEAN BAPTISTE POINT.

SABLE ISLAND

SABLE ISLAND, known to sailors as the *graveyard of the Atlantic*, lies in the North Atlantic shipping lane between North America and Europe. It is about 90 miles (140 kilometers) from Nova Scotia. The island is 20 miles (32 kilometers) long and 1 mile (1.6 kilometers) wide. It is made up of white sand dunes. Cranberries flourish on the island, but no trees or shrubs grow. Canada maintains a life-saving station, wireless station, meteorological station, and two lighthouses there. Only the station operators live on the island.



WORLD BOOK map
Location of Sable Island

A small herd of wild ponies roams the dunes on the island. Supposedly these animals are the descendants of horses that survived a shipwreck in the 1500's.

Dangerous submerged sand bars lie near the island. So many ships were wrecked off the island in the 1700's that many adventurers came there to pillage the cargoes. In 1804, Nova Scotia established a lifeboat crew and armed guard there. Radar and other aids now prevent most accidents. Tremendous seas break on Sable Island, and the west end is gradually washing away. Since the mid-1800's, the west lighthouse has had to be moved several times. In the early 1970's, deposits of oil and natural gas were discovered on Sable Island and in offshore areas. THOMAS H. RADDAL

SABOTAGE, *SAB uh tahzh*, is any means of deliberately wasting or damaging the tools, machinery, or production of an employer or government. The word originated in the 1800's when French workers would throw their *sabots* (wooden shoes) into machines to halt production. In Spain, France, and Italy, sabotage was used by the *syndicalists*, members of anarchist trade unions. In England, forms of sabotage were called "ca'canny" or "soldiering" on the job.

For about 10 years before World War I, the Industrial Workers of the World (IWW) advocated sabotage as part of the workers' strategy in disputes in the United States. Unions today favor strikes instead of sabotage.

In wartime, sabotage by trained agents called *saboteurs* is a means of damaging war production and communications in enemy countries. Enemy attempts at sabotage against the United States have never caused important damage to U.S. war efforts. ROBERT D. PATTON

See also FIFTH COLUMN.

SAC. See STRATEGIC AIR COMMAND.

SAC INDIANS. See SAUK INDIANS.

SACAGAWEA, *SAK uh juh WEE uh*, SACAJAWEA, or SAKAKAWEA (1787?-1812?), was the interpreter for the Lewis and Clark Expedition to the Pacific Ocean in 1804 and 1805. Sacagawea's name means *Bird Woman*. She was born among the Shoshoni, or Snake, Indians of Idaho. Enemy Indians captured her, and sold her as a slave to a French-Canadian trader, Toussaint Charbonneau. Charbonneau and Sacagawea joined the Lewis and Clark Expedition as it passed up the Missouri River. Sacagawea was the principal guide of the expedition. While crossing the Continental Divide, the explorers met relatives of Sacagawea among the Shoshoni. She was able to get food and horses that the travelers needed to continue their journey to the Pacific Ocean and back (see LEWIS AND CLARK EXPEDITION).

Almost nothing was known of Sacagawea for a hundred years after the journey. According to one account, she died on the Missouri River in 1812. Others have contended that she died and was buried on the Wind River Reservation in Wyoming in 1884. An entry in Captain Clark's journal of 1825-1828 lists her as dead.

Sacagawea has been honored by having a river, a peak, and a mountain pass named after her. Monuments and memorials to her stand at Portland, Ore., Three Forks, Mont., Bismarck, N. Dak., Lewiston, Ida., and near Dillon, Mont. WILLIAM H. GILBERT

SACCHARIDES, *SAK uh rydz*, are carbohydrates that differ in chemical structure. Carbohydrates can be classified according to the number of *monosaccharides* (simple saccharide units). Monosaccharides, such as the sugar *glucose*, are made up of a chain of five or six carbon atoms, which cannot be broken down by enzymes or dilute acids. Carbohydrates called *disaccharides*, such as the sugar *sucrose*, contain two monosaccharide units linked by an oxygen atom. *Oligosaccharides* are made up of from two to ten monosaccharide units with oxygen links. *Polysaccharides*, such as starch and cellulose, may have thousands of units. Most oxygen links can be split easily by acids or specific enzymes. See also CARBOHYDRATE; STARCH. DEXTER FRENCH

SACCHARIMETER. See POLARIZED LIGHT (Uses).

SACCHARIN, *SAK uhr ihn* (chemical formula, $C_6H_4SO_2NHCO$), a white crystal powder, is used for sweetening. Saccharin is a compound made from toluene, which is made from coal tar and from petroleum. It is 400 to 500 times as sweet as table sugar, but contains no carbohydrates and has no food value. It is used pri-

Detail of *Lewis and Clark at Three Forks*, a mural (1912) by Edgar S. Paxson; Capitol, Helena, Mont. (Jorud photo)

Sacagawea Guided Explorers Lewis and Clark on their expedition across western lands to the Pacific Ocean.

marily in diseases such as diabetes, where it is harmful for the patient to use sugar. Persons dieting to lose weight often use saccharin in place of sugar. Since saccharin has no food value, United States Pure Food and Drug laws bar its use in most commercial foods.

Saccharin is made into tiny tablets. It is also manufactured in liquid form. It was discovered in 1879 by a German chemist, Constantin Fahlberg, and an American chemist, Ira Remsen.

SACCO-VANZETTI CASE was a famous trial in the United States in the 1920's. It attracted world-wide attention because of the political beliefs of the defendants. Two Italian aliens, Nicola Sacco and Bartolomeo Vanzetti, were accused of killing a paymaster and his guard in South Braintree, Mass., and stealing about $16,000. After many legal delays, the two were executed in August, 1927. Many persons believed they were convicted because they were philosophical anarchists, not because of the evidence presented (see ANARCHISM).

SACHS, JULIUS VON (1832-1897), a German botanist, was a distinguished teacher and the founder of the science of plant physiology. His epoch-making *Textbook of Botany* (1868) had great influence in the United States by emphasizing the use of living plants in teaching botany. His *History of Botany* (1875) is one of the best sources of information about all aspects of botany up to 1860. Sachs was born in Breslau, Germany (now Wrocław, Poland). ROGERS MCVAUGH

SACHS, NELLY (1891-1970), was a German-born poet and dramatist. She shared the 1966 Nobel prize for literature with Shmuel Yosef Agnon "for her outstanding lyrical and dramatic writing, which interprets Israel's destiny with touching strength." Her lyric poetry and verse plays are filled with compassion for the suffering and persecution the Jewish people have endured. She wrote in German. Her poetry has been collected in *And No One Knows Where to Go* (1957) and *Flight and Metamorphosis* (1959). Her best-known play is *Eli: A Miracle Play of the Sufferings of Israel* (1950).

Nelly Sachs was born in Berlin. She fled to Sweden in 1940 when threatened with arrest by the Nazis. She later became a Swedish subject and translated the works of many Swedish poets into German.

SACKVILLE, New Brunswick (pop. 3,180), a town near Nova Scotia, lies about 127 miles (204 kilometers) east of Saint John (see NEW BRUNSWICK [political map]). It lies at the edge of the Tantramar Marshes, around which the early settlers built dikes. The name *Tantramar* comes from a French word meaning a *racket* or *hubbub*. The noise comes from ducks and geese who live there during the spring and the fall.

Sackville is the center of a farming district noted for the growing of small fruits, especially strawberries. Rich hay is grown on the marshes. The town has a number of industries, including stove foundries, and woodworking and box factories. Canada's International Short Wave Service, the *Voice of Canada*, is in Sackville. Mount Allison University is also there. W. S. MACNUTT

SACKVILLE-WEST, VICTORIA MARY (1892-1962), was an English writer whose books reflect her aristocratic, country family background. Her best-known novel, *The Edwardians* (1930), examines English upper-class life during the reign of Edward VII in the early 1900's. Set against a background of country houses and estates, the book attempts to capture the social and emotional flavor of that time. She also wrote of country living in the novels *All Passion Spent* (1931) and *The Dark Island* (1934); in the nonfiction books *Country Notes* (1939), *English Country Houses* (1941), and *In Your Garden* (1951); and in many of her poems. Her best-known book of poetry is *The Land* (1929).

Victoria Sackville-West was born in Knole Castle, a country house given to her ancestors by Queen Elizabeth I. She traveled widely with her husband, diplomat-author Sir Harold Nicolson. They bought an estate in Kent in the 1930's, and she died there. Nigel Nicolson, their son, described their marriage in *Portrait of a Marriage* (1973). JOHN ESPEY

SACO RIVER. See MAINE (Rivers and Lakes); NEW HAMPSHIRE (Rivers and Lakes).

SACRAMENT, *SACK ruh munt*, is a solemn observance in the Christian church. It is an outward sign that a faithful worshiper is receiving the grace of God. The Eastern Orthodox and Roman Catholic churches have seven sacraments—Baptism, Confirmation, Holy Eucharist, Penance, Anointing of the Sick, Holy Orders, and Matrimony. Most Protestant churches recognize two sacraments—Baptism and Communion, or Lord's Supper. Quakers do not observe outward forms, but consider all life a sacrament. Roman Catholics believe that sacraments aid salvation. Most Protestants see them as visible signs of agreement between God and individuals. See also ROMAN CATHOLIC CHURCH; EASTERN ORTHODOX CHURCHES (Sacraments); ANOINTING OF THE SICK; BAPTISM; CONFIRMATION; COMMUNION; MARRIAGE. FULTON J. SHEEN

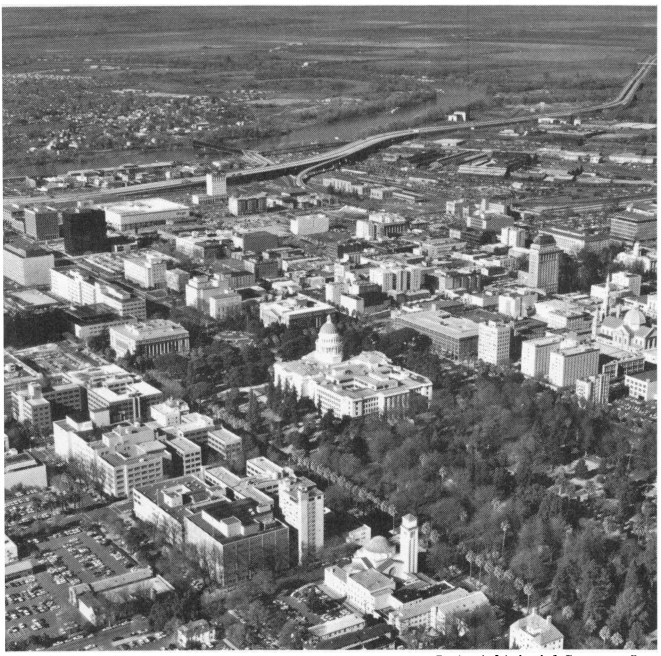
SACRAMENTO, *SACK ruh MEN toh*, Calif. (pop. 257,105; met. area 803,793), is the state capital and the commercial center of a rich farming region. It lies at the junction of the Sacramento and American rivers in California's Sacramento Valley, about 85 miles (137 kilometers) northeast of San Francisco. For location, see CALIFORNIA (political map).

Sacramento is a historic city of the American West. It was founded as a town in 1849 by John A. Sutter, Jr., son of the Swiss pioneer who established the first white settlement in the area. Sacramento became a mining center during the California gold rush of 1849. Construction of the Central Pacific Railroad, a link in the first railway to cross the United States, began in Sacramento in 1863. Industry began to grow rapidly in the city during the late 1940's. Today, Sacramento ranks among the nation's fastest-growing urban centers.

The City. Sacramento, the county seat of Sacramento County, covers about 96 square miles (249 square kilometers). The Sacramento metropolitan area spreads over three counties—Placer, Sacramento, and Yolo.

The state Capitol stands in Capitol Park, which occupies 40 acres (16 hectares) in the heart of Sacramento (see CALIFORNIA [color picture: State Capitol]). The city originally lay along the east bank of the Sacramento River. Many structures built there during the mid-1800's have been preserved as part of a renewal program. The Sacramento Army Depot, a storage center for U.S. Army signal equipment, is in the southeastern section of the city. Mather and McClellan Air Force bases lie outside Sacramento.

About 95 per cent of Sacramento's people were born



Cartwright Aerial Surveys, Inc.

Sacramento lies along the Sacramento River. The domed state Capitol is in Capitol Park at the edge of the business district.

in the United States. People of Mexican ancestry make up about 15 per cent of the population, and Negroes account for about 13 per cent. Other groups in Sacramento include those of Canadian, Chinese, German, Italian, and Japanese descent. Roman Catholics form the city's largest religious group, followed by Methodists, Presbyterians, and Baptists.

Economy of Sacramento depends heavily on governmental operations. Federal, state, and local government agencies employ about a third of the workers in Sacramento's metropolitan area. The state of California, Sacramento's largest single employer, operates more than 25 government buildings in the city.

Sacramento has about 300 manufacturing plants. Rocket engine production ranks as the city's leading industry, followed by food processing. Fruit and vegetable canneries in the Sacramento area process and pack more than half of California's agricultural products. Sacramento's other chief products include boxes, fertilizer, flour, furniture, and soap.

A deepwater channel, completed in 1963, links the Port of Sacramento to San Francisco Bay and the Pacific Ocean. The port serves ocean-going ships, which pick up rice and other exports of the Sacramento Valley. Railroad passenger trains, four rail freight lines, and four major highways serve Sacramento. A number of airlines use Sacramento County Metropolitan Airport, which lies outside the city. Sacramento Executive Airport serves business and private aircraft.

Education and Cultural Life. Sacramento's public school system has about 65 elementary schools and 7 high schools, with a total enrollment of more than 50,000. There are also more than 20 church-supported schools. The city is the home of the McGeorge College of Law of the University of the Pacific, and California State University at Sacramento. The University of California has a branch campus in nearby Davis.

The Sacramento Public Library, in downtown Sacramento, has five branches. The E. B. Crocker Art Gallery, the oldest art museum in the West, opened in Sacramento in 1885. It features paintings by European masters. The Sacramento County and City Museum, also in Sacramento, has exhibits on the city's history. A fort built in 1839 by the pioneer settler John A. Sutter has been restored in the eastern section of the city.

Cultural groups in Sacramento sponsor ballet, opera, symphony orchestra, and theater programs. The California State Fair is held in Sacramento every August and September. The city has about 50 parks. William Land Park, the largest, covers 236 acres (96 hectares). It includes a golf course and a zoo with over 450 animals and birds. Sacramento's two daily newspapers are the *Bee* and the *Union*. The *Union*, California's oldest newspaper, began publishing in 1851. Eighteen radio stations and four television stations serve Sacramento.

Government. Sacramento has a council-manager form of government. The people elect a mayor and eight other members of the city council to four-year terms. The council hires a city manager as the administrative head of the city government. Property taxes provide about half of Sacramento's income. Gas and sales taxes are other important sources of income.

History. In 1839, a group of settlers led by John A. Sutter, a Swiss pioneer, established a colony along the American River. The colony lay about 2 miles (3.2 kilometers) east of the Sacramento River. It was the first white settlement in inland California, then controlled by Mexico. Sutter received about 50,000 acres (20,000 hectares) of land in the area by pledging loyalty to Mexico. In the 1840's, his fort was the western terminal for wagon trains of pioneers. See PIONEER LIFE IN AMERICA (color picture: Reconstruction of Sutter's Fort).

In 1848, the discovery of gold at Sutter's sawmill drew thousands of fortune seekers to the area. The next year, Sutter's son, John A. Sutter, Jr., founded the town of Sacramento along the east bank of the Sacramento River. The town was named for the river. During the gold rush of 1849, Sacramento became a center of mining activities and its population soon rose to 10,000. Sacramento was incorporated as a city in 1850 and became the state capital in 1854.

In 1860 and 1861, daring riders of the pony express carried the U.S. mail between Sacramento and St. Joseph, Mo. (see PONY EXPRESS). In 1863, construction of the Central Pacific Railroad, the first railway system to cross the Sierra Nevada mountains, began in Sacramento. In 1869, the Central Pacific connected with the Union Pacific at Promontory, Utah, and became part of the nation's first coast-to-coast link.

During the late 1800's, farmers started to grow cotton, fruits, and vegetables in the Sacramento Valley. Sacramento became an important trading center for these crops. Between 1870 and 1900, the city's population increased from 16,283 to 29,282. Agriculture in the Sacramento area continued to develop rapidly in the early 1900's, and canning and food processing became Sacramento's chief manufacturing activities. By 1930, the city's population had climbed to 93,750.

After World War II ended in 1945, many new industries, including rocket engine production, began in

Sacramento. The city started to annex large areas of nearby vacant land during the 1950's. Between 1950 and 1960, Sacramento's area increased from 17 square miles (44 square kilometers) to about 43 square miles (111 square kilometers). During this same period, the city's population grew from 137,572 to 191,667.

In the 1950's and 1960's, a number of large shopping centers opened in Sacramento's suburbs and took retail trade away from the city's merchants. The city began to rebuild its downtown area in 1960. Decaying buildings were torn down, and modern stores, banks, and office buildings took their place. Completion of this project was scheduled for the late 1970's. STEVEN M. GIBSON

SACRAMENTO RIVER is the largest waterway in California. It drains the fertile Sacramento Valley in the northern part of the Central Valley of California. The river rises near the slope of Mount Shasta and flows south into Suisun Bay (see CALIFORNIA [physical map]). The Sacramento River is 382 miles (615 kilometers) long. Small boats can sail to Red Bluff, 256 miles (412 kilometers) above the river's mouth. Larger boats can sail 67 miles (108 kilometers) to the city of Sacramento.

The main branches of the Sacramento flow into it from the Sierra Nevada. Many smaller streams join the river from the Sierra Nevada and from the Coast Ranges. The Feather River is the chief eastern tributary.

In 1945, the U.S. Bureau of Reclamation completed the Shasta Dam and Reservoir. This is part of the Central Valley Project. See CENTRAL VALLEY PROJECT; SHASTA DAM. C. LANGDON WHITE

SACRED BAND. See PELOPIDAS.

SACRED COLLEGE is the entire body of cardinals, who are appointed by the pope and share with him the government of the Roman Catholic Church. The Sacred College is also called the College of Cardinals. In influence and position, the college ranks second only to the pope. For the number of cardinals in the Sacred College, see the CARDINAL article.

Traditionally, there are three orders of cardinals in the Sacred College: cardinal bishops, cardinal priests, and cardinal deacons. In general, their duties consist of administering the affairs of the church under the direction of the pope. But their greatest responsibility comes after the pope dies. Then they must meet to elect someone, customarily one of their own members, as his successor. During this election, they have no contacts with the outer world. FULTON J. SHEEN

See also CONCLAVE; POPE; ROMAN CATHOLIC CHURCH.

SACRED FIRE. See FIRE (Fire in Legend and Religion).

SACRED HEART, COLLEGE OF THE. See UNIVERSITIES AND COLLEGES (table).

SACRED HEART OF JESUS, SOCIETY OF THE, is a Roman Catholic society of women, established for the education of youth and to provide centers for retreats. It was founded in Paris in 1800 by St. Madeleine Sophie Barat. The society has 188 houses, which include colleges, academies, and elementary and high schools. The schools are located in 32 different countries, including the United States, Canada, and Mexico. The mother house is in Rome. FULTON J. SHEEN

SACRED HEART SEMINARY COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SACRED HEART UNIVERSITY. See UNIVERSITIES AND COLLEGES (table).

SACRED MUSIC is music with a religious subject or theme. It is used chiefly in church services and by many types of musical organizations. See also CHRISTMAS (Music); HYMN; MUSIC (History); ORATORIO.

SACRED WAY. See ROME (Forums).

SACRIFICE is a religious ceremony in which something is given to a god or the gods, thus becoming "holy." The word comes from two Latin terms meaning *to make holy*. Persons making the sacrifice expect to receive some physical or spiritual good. Sacrifices have included food, animals, and even people.

There are many theories about the origin of sacrifice. Some persons claim that it was divinely instituted. Others believe that it developed from men's inner conflicts, uncertainties, or feelings of guilt and remorse. Fear of the gods and the unknown, and desire for favors, probably helped it emerge. Psychiatrists point out that persons troubled by feelings of guilt are often prone to accidents as a kind of disguised sacrifice.

Many religions include a ritual of sacrifice, often symbolically. Orthodox Christianity teaches that the sacrifice of Jesus makes other sacrifices unnecessary. The Jews have not used sacrifice since A.D. 70, when the Temple in Jerusalem was destroyed. Some religions, such as Buddhism, oppose sacrifice. FLOYD H. ROSS

See also ALTAR; ATONEMENT; GEHENNA; HECATOMB; MOLOCH; MYTHOLOGY (American Indian).

SACRISTY. See CLOISTER.

SACROILIAC JOINT, *SAY kroh IL ee ack*, connects the backbone with the pelvis. The V-shaped sacrum bone near the bottom of the backbone fits like a wedge between the wide wings of the *ilium* (hipbone). Ligaments and plates made up of cartilage connect the bones. Inflammation or strain on this joint often causes aching in the lower back. W. B. YOUMANS

SACRUM. See PELVIS.

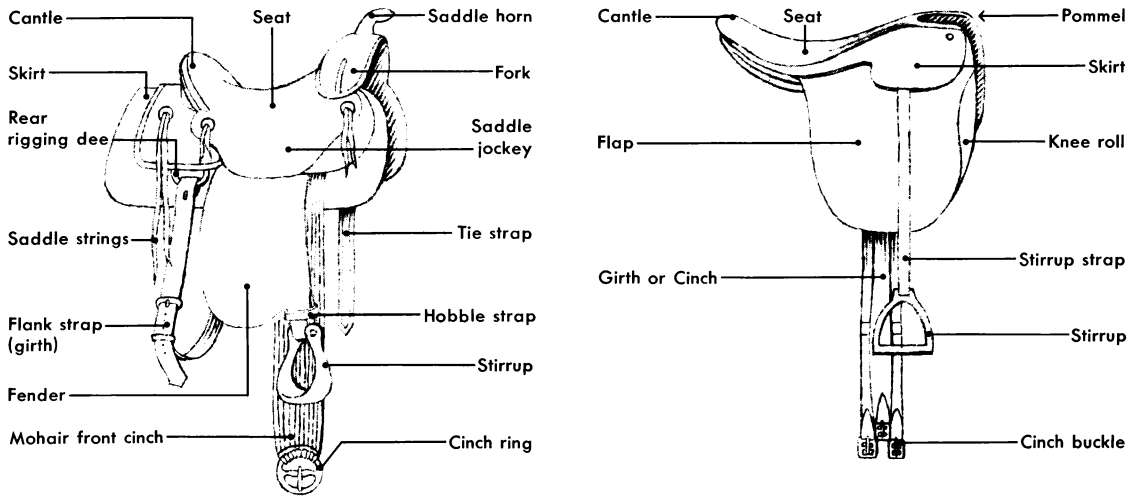
SADAT, *suh DAHT*, **ANWAR** (1918-), became president of Egypt in 1970, after the death of President Gamal Abdel Nasser. Sadat had served as vice-president of Egypt from 1964 to 1967 and again from 1969 to 1970.

Under Sadat's leadership, Egypt adopted a new constitution in 1971. This constitution lessened many of the controls over the people's lives that had been in effect during Nasser's rule. Like Nasser, Sadat demanded the return of Egyptian land occupied by Israel after the Arab-Israeli war of 1967. Sadat also signed a treaty of friendship with Russia and helped establish a *federation* (union) of Egypt, Libya, and Syria.

Sadat was born in a village in the Nile River delta. He graduated from the Egyptian Military Academy in 1938. He then joined Nasser and other young military officers in a secret organization that worked to overthrow the government and rid Egypt of British influence. Sadat was imprisoned during the 1940's for his revolutionary

Wide World

Anwar Sadat



WORLD BOOK illustration by James Teason

The Most Popular Kinds of Saddles are the Western saddle, *left*, and the English saddle, *right*. Rodeo riders and cowboys use Western saddles. Jockeys and horse show riders use English saddles.

activities. In 1952, he helped lead the revolt that overthrew King Faruk. Sadat held a series of important government positions after the uprising. FRANK TACHAU

SADDLE is a seat used by a rider on a horse. There are many different kinds of saddles. They range from a mere blanket, such as the Indians used, to the saddles of the feudal knights, which supported them firmly on their horses when they were struck with a lance or spear.

The main parts of most saddles are a *seat*, usually made of leather; a *girth* (strap) underneath the horse, which may be tightened to secure the saddle; and *stirrups* for the rider's feet. There is usually a *pad* under the seat to protect the horse's back from irritation, and a leather *flap*, which hangs down on both sides of the horse to protect its sides.

The two most common saddles in America are the *English* and the *Western*. The English saddle is almost flat, with only a slight curve in the seat. The front of the seat comes to a slight point called the *pommel*, while the back is wider and slightly raised to form the *cantle*. The Western saddle has wide stirrups, a high cantle, and a pommel raised to make a *horn* to which a lariat may be fastened. GEORG MANN

See also HORSE (Riding Equipment).

SADDUCEE, *SAD yoo see*, was a member of a religious group that was active in Judea until Jerusalem fell in A.D. 70. The Sadducees gained influence in Judea when Rome ruled the land. They opposed the Pharisees in religious beliefs and practices. They accepted only the written law of the Hebrew Bible, and refused to recognize the Oral Law as binding upon them (see ORAL LAW). The Sadducees did not believe in immortality, as the Pharisees did. They said that the soul died with the body. They believed that each person had free will and was responsible for whatever good or evil befell him. See also PHARISEE; TALMUD. LOUIS L. MANN

SADE, *sahd*, **MARQUIS DE** (1740-1814), was a controversial French novelist and essayist. His works were considered so obscene that many of them remained unpublished until the mid-1900's. Today, some people regard Sade as having been insane and his works as offensive. But many other people consider him a brilliant writer with a descriptive, eloquent style.

Donatien Alphonse François Sade was born in Paris. He served as a cavalry officer in the Seven Years' War (1756-1763). During his 20's, Sade began to show signs of being mentally disturbed. He became involved in many scandals over his acts of cruelty and his sexual behavior. Sade spent most of the years from 1768 to 1803 in prison for his writings and his actions. He was placed in an asylum in 1803 and died there.

Sade produced many essays, plays, and short stories, as well as novels. His best-known novels include *Justine, or the Misfortunes of Virtue* (1791) and *Philosophy in the Bedroom* (1795). His *120 Days of Sodom* was not published until 1904.

In his writings, Sade tried to show that criminal acts and sexual abnormalities are natural to human behavior. The word *sadism* comes from his name. Sadism is the enjoyment of cruelty, especially—as in the case of Sade—for sexual satisfaction. Sade's writings influenced writers of the surrealism movement of the 1900's. His works are used to illustrate certain psychological theories. IRVING PUTTER

SADI, an alternate spelling of Saadi. See SAADI.

SADISM. See MENTAL ILLNESS (Terms).

SADOWA, BATTLE OF. See SEVEN WEEKS' WAR.

S.A.E. RATING. See HORSEPOWER.

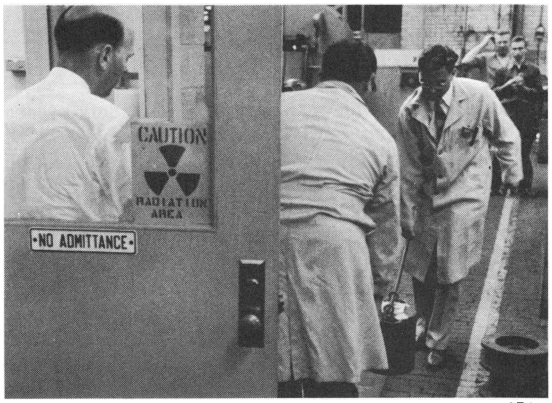
SAFARI, *suh FAR ee*, is an organized hunt in Africa. Hunters join safaris for a chance to kill Cape buffaloes, elephants, leopards, lions, rhinoceroses, or other big game. An organized trip to photograph wild animals is also called a safari.

Most safaris last from three to six weeks. Most of them are organized by a safari company that provides all the necessary supplies and personnel.

Many African countries limit the number and kind of wild animals that may be killed. Some also specify the weapons that may be used to kill certain animals.

See also ROOSEVELT, THEODORE (Later Years).

SAFEGUARD, missile. See NIXON, RICHARD M. (The National Scene).



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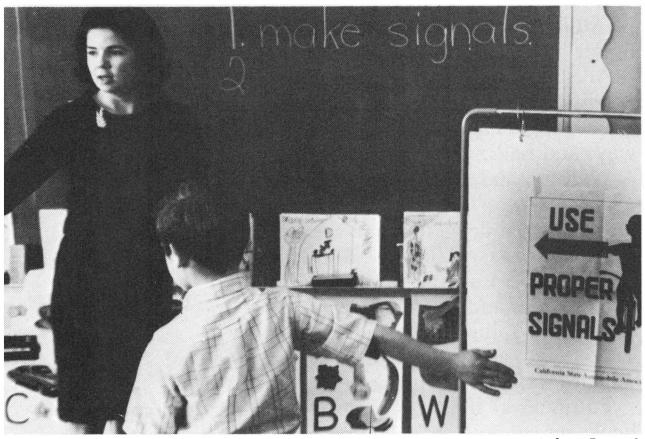


National Safety Council

WORLD BOOK photo by Rie Gaddis

SAFETY

SAFETY has always been one of man's greatest concerns. Primitive man lived in caves or treetops to protect himself from dangerous wild beasts and enemy tribes. He soon learned to cover the entrance to his cave with a huge rock or to pull his ladder of vines up out of reach.

As time went on, man invented tools and weapons. He learned to build stronger and safer places in which to live. His cave or tree house became a stone-walled castle. The rock blocking the entrance became a door, his ladder of vines a moat.

Man gradually overcame many of the dangers and discomforts that surrounded him. Many of the dangerous animals died out.

But as natural dangers disappeared, new perils took their place. The machines man built to serve him often betrayed and destroyed him. Man invented machines quickly but did not know how to use them safely. He built better roads and bridges, but invented dangerous vehicles to drive over them. He sailed bigger and safer ships, but to more distant and dangerous places. Fire became his enemy as well as his friend.

Today's crowded living conditions have also brought new dangers. People rely on one another more today than ever before. The careless act of one person, driving an automobile or a bicycle, flying an airplane, or operating a machine can affect the safety of many.

Despite these new and greater dangers, people live more safely today than at any time in history. Since the early 1900's, accidents in the United States have declined by more than one-third, in proportion to the population.

Most accidents can be prevented by combining proper engineering, enforcement, and education. Safety *engineering* produces such safety devices as seat belts for automobiles and airplanes, and guards and shields that protect persons operating machines. Safety *enforcement* includes rules in sports, in schools, on transportation, and in industry that require individuals to take the proper safety precautions and wear the proper equipment. Safety *education* makes people aware of hazardous conditions and teaches them how to perform the most dangerous tasks safely.

Living safely does not mean living a dull life. The greatest safety precautions of all are required for those tasks that are the most dangerous and exciting. Astronauts, explorers, deep-sea divers, and others who live under the most dangerous conditions, take every possible precaution. Otherwise they could not hope to accomplish their missions. Without safety precautions, most of history's great adventures would have been halted by accidents.

SAFETY/HOME

Most people think of their homes as the safest place. But the home may be the most dangerous place of all, according to the National Safety Council. About 40 per cent of all accidental injuries and 25 per cent of all accidental deaths occur in the home. Nearly every home accident occurs because someone carelessly breaks a simple rule of safety or does not realize the dangers involved.

Falls cause nearly half of all the accidental deaths that occur in homes. Slippery floors, unmended worn spots in rugs, loose treads on stairs, and objects carelessly littered about the home are major causes of falls.

If you and the people in your home follow these simple rules, your home will be a safer place in which to live:

All stairways should have handrails that are in good condition. Stair treads should be firm and uniform.

Place lights and light switches at both ends of stairways and halls.

Walk up and down stairs carefully.

Never leave objects on stairs or floors.

Buff waxed floors to make them less slippery.

Do not place small rugs on slippery floors.

Use rubber underpads to anchor rugs.

Keep rugs and carpets mended.

Wipe up spilled liquids immediately.

Cover icy sidewalks with salt, sand, or ashes.

Place rubber mats in showers and bathtubs.

Put gates at the head and foot of stairs, and strong hooks on window screens to protect small children.

Fasten children securely into carriages and high chairs.

Never overburden yourself with large packages or heavy objects.

Turn on lights before entering dark rooms.

Do not sit on window sills, lean out windows, or tilt back on chairs.

Burns and Scalds rank second only to falls as a cause of accidental deaths in the home. Nearly every burn results from carelessness or ignorance of safety rules. Hot or burning objects such as cigarettes, matches, stoves, fireplaces, furnaces, and outdoor barbecues cause most burns and scalds. A little bit of extra care around such objects can help keep your home and the people in it safe from fires, burns, and scalds. See BURNS AND SCALDS; FIRE PREVENTION.

Here are some rules to follow:

Keep matches in a safe, fireproof container, out of the reach of small children and away from heat sources.

Always strike matches away from your body so the head of the match will not burn you if it should fly off.

Never use lighted matches in closets, or near any flammable materials.

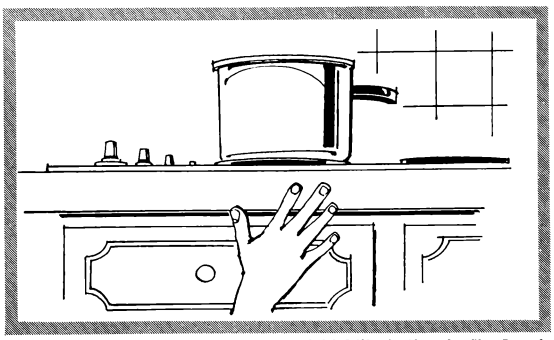
Be sure that smokers put cigarettes, cigars, and pipe ashes in ash trays.

Place candles or fuel burning lanterns on a firm base so they won't fall or tip over. Be sure that the last person to go to bed or to leave the house puts them out.

Keep Stairways Clear of toys and other objects that might cause you or someone in your family to trip and fall.

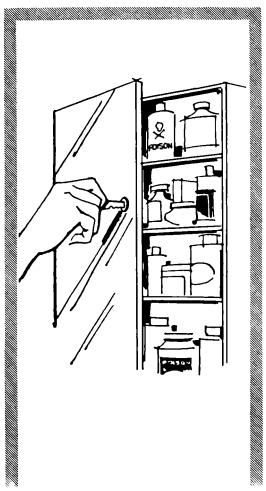
Never Climb On Chairs, tables, or boxes to reach high places, *left*. Use a stepladder to avoid injury from a fall.

Avoid Burns and Scalds by turning pot and pan handles toward the back of the stove, *below*. Keep matches away from youngsters and heat sources.



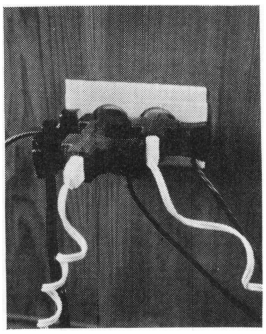
WORLD BOOK illustrations by Jim Joseph

Keep Medicine Locked Up and out of reach, *below*. Be sure containers are clearly marked.



Overloaded Wall Sockets, *below*, and poorly placed cords cause many damaging fires.

WORLD BOOK photos by Rie Gaddis



Never clean with flammable dry-cleaning fluids.

Never start fires with gasoline or similar products.

Use charcoal lighter fluids or kerosene to start fires. But never use these devices to restart fires from embers.

Cover fireplaces with spark screens.

Keep fireplaces, flues, and chimneys free of obstructions.

Turn pots and pans so their handles point to the rear of the cooking surface out of reach.

Open both the broiler and oven doors when lighting gas ovens. Turn the gas on after striking the match, never before.

Smother burning fat with a metal cover or bicarbonate of soda. Never use flour. It may explode.

Be sure that all furnaces and heat sources, and all cooking appliances, are in good working condition.

Poisoning causes many accidental deaths in homes each year. Potential danger areas are medicine cabinets, and places such as garages or basements where such poisonous substances as cleansers, paints, and insecticides are stored.

Extra care should be taken in these areas when children and pets are present. If anyone should swallow a substance you think may be poisonous, read the instructions on the label to find a quick remedy, then call a physician immediately. If possible, tell the physician the brand name and contents of the product so he can determine the best remedy as quickly as possible. See ANTIDOTE; FIRST AID.

These simple rules will help avoid accidents from poisoning: before they happen:

Lock all medicine cabinets and all places where poisonous substances are stored. Keep poisons out of reach of children.

Label all bottles clearly.

Never take medicine without reading the label.

Never take medicine in the dark.

Inspect medicine cabinets regularly and throw away medicines that are no longer being used.

Put away all poisonous substances immediately after using them.

Keep children and pets away from areas recently painted or covered with insecticides, plant sprays, or other poisonous substances.

Throw away food that is no longer fresh.

Asphyxiation. Many persons die needlessly from gas poisoning or from choking on food or other objects. Faulty gas stoves, furnaces, or other gas-fueled appliances and poor ventilation cause most gas poisoning. Automobiles with motors running in closed or poorly ventilated garages also cause many deaths. See FIRST AID (Restoring Breathing).

Here are some ways to prevent asphyxiation:

Have heating equipment inspected regularly.

Never operate automobile engines or gasoline-powered motors in closed areas such as a closed garage. They produce poisonous carbon monoxide gas.

Be sure that all heating and cooking appliances are properly vented to dispose of gas.

Make all gas connections with metal piping, never with rubber hose. Be sure that all fittings are tight.

Report all gas leaks to the utility company the instant you notice them.

Do not let young children play with coins, marbles, or other small objects they might choke on.

Never give popcorn or food with nuts to children under four years of age.

Cuts and Scratches usually cause only minor injuries. But if they are not treated properly, they may be serious.

Most cuts and scratches can be avoided by handling tacks, nails, broken glass, knives and other cutting tools, and metal objects with sharp edges carefully. Such a seemingly harmless object as paper can also cause painful cuts.

Here are some ways to avoid cuts and scratches:

Keep sharp or pointed objects out of the reach of children.

Pick up tacks, pins, needles, and other sharp objects immediately.

Remove all nails and splinters from boards before the boards are stored.

Sweep up broken glass immediately. Always pick up glass slivers with a paper towel, never with your bare hands.

Learn the right way to use cutting tools before starting to work with them. The right way is always the safe way.

Treat all cuts or scratches that break the skin.

Serious cuts, or bleeding that will not stop, should be treated by a physician as soon as possible.

Safety With Electricity. Faulty electrical wiring can cause fires, dangerous electric shocks, and even death. All electrical appliances and areas where electrical wiring is used are potential danger spots. See ELECTRICITY (How to Use Electricity Safely).

Here are some rules to follow:

Have all wiring done by a competent electrician.

Electrical wiring and appliances should bear the Underwriter's Laboratories label on all parts.

Replace any cords and plugs showing frayed or cracked insulation or other signs of wear.

Never run cords over radiators, under rugs, or through doorways.

Have extra outlets installed by an electrician instead of using long extension cords.

Never touch electric cords, wires, or fixtures if your hands, feet, or shoes are damp.

Never jerk cords out of outlets. Grip the plug only.

Other Home Hazards. Most new home appliances require some safety measures. Power mowers and snow shovels, electric hedge clippers, and power tools are examples of these.

For safety follow these rules:

Never repair, service, or fuel machines or tools when they are operating.

Always learn to use a new tool safely before you attempt to use it.

Follow manufacturers' instructions to the letter when assembling, repairing, servicing, and using all products.

SAFETY/*SCHOOL*

Except for their homes, young people spend more time in schools than they do anywhere else. Special safety rules apply to school buildings. For example, doors should open easily, even for the smallest children. Exits, fire escapes, and emergency equipment should be clearly marked.

Accidents that occur in schools are especially tragic when they result from carelessness, faulty equipment, rowdyness, or foolish horseplay.

Each student must recognize his responsibility not only for his own safety, but also for the safety of other students. This responsibility is especially true for older students.

Corridors, Stairs, and Classrooms. Accidents can occur easily in corridors and on stairways. Everyone is in a hurry to get to the next class or to go home. Crowded corridors and stairways are like streets and highways during rush-hour traffic. Just as automobiles move faster and safer with traffic regulations, students will get where they are going faster and safer by following a few simple traffic rules in corridors and on stairways.

Classrooms are usually less dangerous than corridors and stairways. But serious and painful injuries can also occur there unless normal safety regulations are observed.

These rules will help avoid accidents:

Keep to the right in corridors and on stairways. Do not crowd or shove.

Walk, do not run.

Use each step going up and down stairs. Be ready to grab the handrail if you slip.

Keep classroom aisles and cloakrooms clear of obstacles.

Hang up coats and keep overshoes and umbrellas out of the way.

Report broken seats, desks, and other damaged equipment.

Put away materials you are not using.

Keep feet out of aisles.

Do not tip chairs back.

Carry pens, pencils, scissors, and other sharp objects with points down and protected. Be careful when using them.

Gymnasiums and Athletic Fields are where more than half of all school accidents occur. Some injuries can be expected during vigorous physical activity, but many of them could be avoided. Proper equipment and good physical condition are essential. Sportsmanship also promotes safety.

The best players in any sports are those who follow the rules. They are less likely to be injured, so they are more valuable to themselves and to their teams. Precautions must be taken by students and by school authorities as well.

Here are some ways to avoid injuries in gymnasiums and on athletic fields:

Cover pillars and walls and other obstacles close to playing areas with padding.

Keep fields clear of broken glass, bits of metal, sticks, and trash of all kinds.

Keep gymnasium floors and playing fields smooth and in good repair.

Inspect equipment, grounds, and facilities regularly and keep them in good condition.

Always have first aid equipment handy and know how to use it.

Be sure you are in proper physical condition and well trained in the fundamentals before you participate in any sport.

Understand the rules of the game and apply them strictly.

SAFETY/*INSTRUCTION*

Safety Instruction has assumed an important place in schools today. With safety engineering and safety enforcement, safety education is one of the three essential factors in maintaining and improving safety conditions.

Safety education neither begins nor ends in the classroom. But schools play an important role in making safety a recognized part of everyday life. Safety education begins in the home during infancy. By the time a child reaches school age, safety has become so much a part of his knowledge and experience that he has no need to think about it.

Many states require safety instruction in school. But required or not, it is part of everyday classroom activities, from the earliest grades through high school and college. It continues on the job and in the home, all through life.

Specific safety courses are not taught in school. Each school subject relates to safety in its own way. Safety receives greater emphasis in such courses as physical education, driver education, vocational courses, fine and practical arts, and social studies, where it relates specifically to the subject matter. But safety is so much a part of life itself that safety education is often taught and learned without the instructor or student realizing it.

School Safety Organizations. Most classroom safety instruction deals with safety as it applies to specific classroom situations or to life in general. But safety also applies to activities and conditions in and around school. For example, perhaps a stairway is poorly lighted. Students may tend to congregate in a particular place in the corridors, creating a bad traffic problem. Perhaps a leaky radiator has made a certain stretch of corridor dangerously slippery. Or there may be a dangerous corner near the school building where a number of traffic accidents have occurred. Either these conditions must be corrected, or students must

Never participate in any sport without using the proper equipment. Be sure the equipment is in good condition. Playing without equipment, or with poor equipment can be dangerous.

Report all dangerous conditions.

Report any injuries to yourself or others at once, whether or not they seem serious.

Do not lose your temper during rough play or physical contact.

Keep spectators clear of the playing area.

Be careful in locker rooms and showers. Accidents there can be even more serious than those that occur on the playing field.

Shops and Laboratories, the training grounds for future scientists, engineers, and industrial workers, have conditions similar to those found in industry. Students learn how to work with the equipment and how to solve the problems they will have to face later on the job.

Schools should also teach students about the hazards found in shops and laboratories and how to protect themselves against them. Shop and laboratory safety precautions should teach students the attitudes toward industrial safety that future employers will expect them to have.

The following common sense rules are important to shop and laboratory safety:

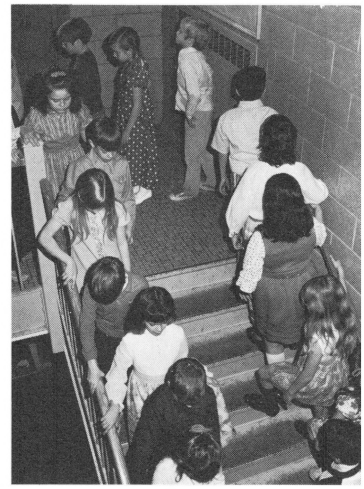
Organize shop and laboratory safety procedures along the same lines as those in industry.

Use the proper safety equipment and wear the proper clothing.

Students should learn how to handle machinery and equipment before they use them.

Inspect tools and equipment regularly. Worn or damaged equipment should be repaired or replaced immediately.

Proper Equipment, *above,* helps to prevent gymnasium injuries and to ensure safety.



Tom Stack and Associates

Courtesy On Stairways, *above,* helps school safety.

Blocked Classroom Aisles, *below,* can cause accidents.

Tom Stack and Associates

Wear Safety Equipment while working in the school shop or laboratory, *below.*

WORLD BOOK illustrations by Jim Joseph

be warned of the dangers so they can take precautions against them.

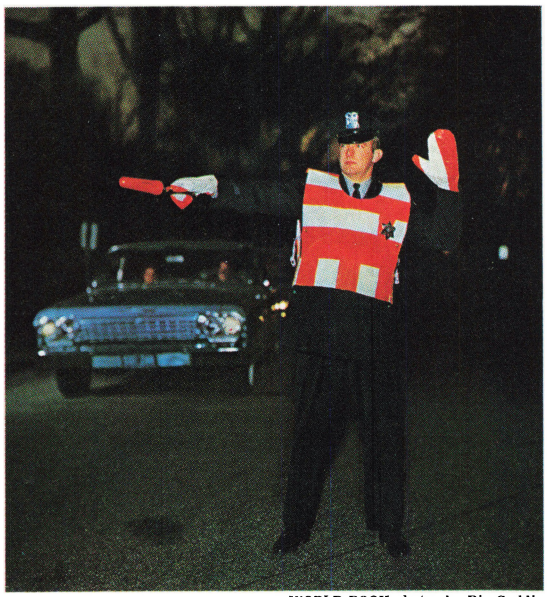
Many schools have created safety organizations made up of students elected by their classmates to help improve safety conditions. The job of the safety organization is to discover hazards in and around the school, and either eliminate them or take precautions against them. Students must cooperate in order that the organization may do its job effectively. Students should follow its recommendations and help by reporting hazardous conditions.

A valuable way to eliminate accidents is by "reporting the accident that almost happened." For example, suppose a bar of steel falls from a storage rack in a machine shop, narrowly missing a student. This incident could easily go unnoticed, because no one was injured and no damage occurred. By someone reporting the mishap to the proper authority the condition can be corrected. Perhaps by sending out a daily or weekly report of "accidents that almost happened," the safety organization can alert students to unsafe conditions around them.

Safety Patrols and School Bus Patrols. Safety patrol boys and girls help students cross streets at the proper places. If a traffic officer is present, the patrol boy or girl works under his supervision. Accepted rules and policies for school safety patrols have been devised by the American Automobile Association, International Association of Chiefs of Police, National Commission on Safety Education of the National Education Association, National Congress of Parents and Teachers, National Safety Council, and the United States Office of Education.

In areas where school buses carry students to and from school, student bus patrols are often formed from older pupils on board. The patrols help drivers take roll, maintain order, and help children on and off the bus and across roads safely.

SAFETY/COLOR

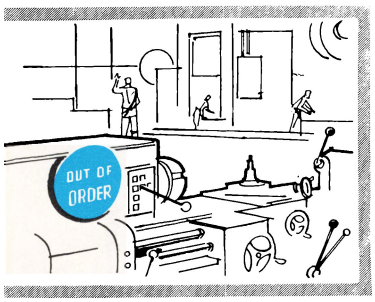


WORLD BOOK photos by Rie Gaddis

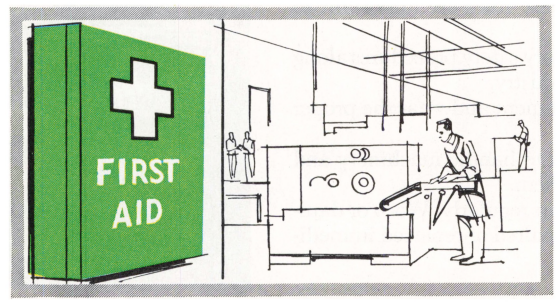
Bright Yellow-Orange is worn by hunters as a safety measure, *above*. They wear it to help other hunters see them.

A Policeman's Safety Vest has bright red and white stripes. The colors help you to see him when he directs traffic, *left*.

Fire Protection Red, *right*, tells you instantly where you will find fire fighting equipment and emergency fire exits.

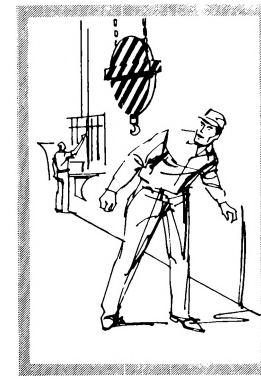


Precautionary Blue warns you. It marks equipment that is out of order and not to be used.



WORLD BOOK illustrations by Jim Joseph

Emergency Green leads you quickly to first aid equipment, *above*, when you need it.



Warning Yellow, *right*, alerts you to take special care in avoiding hazards.

SAFETY/INDUSTRY

WORLD BOOK photo by Rie Gaddis, courtesy General Motors E.M.D.

Color Is Important in Industrial Safety. Colors play a major part in helping to maintain the safety of workers in industrial plants. How many safety colors do you see here?

Industrial safety improvements since 1900 prove that accident prevention works. Organized accident prevention began in 1913 with the founding of the National Council for Industrial Safety. It soon changed its name to the National Safety Council, extending its program to include prevention of all accidents.

In 1912, the year before the safety council was founded, work accidents killed about 21 out of every 100,000 persons in the United States. By the mid-1960's, the yearly rate was about 7 out of every 100,000.

The first steps toward industrial safety came in engineering. Safer machines and equipment reduced accidents. Next came better working procedures, and rules to enforce them. Lectures, motion pictures, and posters are now used to teach safety methods to workers.

Employers demand safe work methods. They know that safety not only reduces accidents and deaths, but that it reduces costs as well.

SAFETY/*RECREATION*

Injuries are never pleasant. But perhaps the worst injuries are those that keep you from doing things you want to do, or that make you stop in the midst of having a good time. Yet, skiers break legs, boaters drown, hunters are shot accidentally, campers lose their way in the woods. In almost every case, these mishaps result from carelessness.

It is easy to relax your guard against accidents during a boat ride or while participating in or watching a baseball game. But accidents are more likely to occur when you do things that are not a part of your everyday routine.

Some activities appear more dangerous than others because the hazards are easier to see. But hidden hazards often cause the worst accidents. As a result, the most "dangerous" activities often have better accident records than the so-called "safe" ones.

Safety precautions that apply to gymnasiums and athletic fields apply also to most forms of outdoor recreation. Proper clothing, equipment, physical conditioning, and training are essential to safety.

Water Safety. Drowning ranks fourth among the causes of accidental death. Most drowning victims could have saved themselves if they had known how to swim.

Nearly everyone spends some time either in or near water. Anyone who goes near water without knowing how to swim, takes unnecessary chances. Swimming is easy to learn and lessons are available to most people. Children can learn to swim at very early ages. School age children should learn to take care of themselves in depths over their heads. Adults can learn to swim at public and private pools and at recreation centers. See ARTIFICIAL RESPIRATION; BOATING; CANOEING (pictures); DROWNING; FIRST AID.

Instruction in all water sports emphasizes safety. Here are a few basic water safety rules:

Always swim with a companion.

If you do not know how to swim well stay in shallow water.

Never go in the water until at least an hour after eating.

At least one member of a swimming party should have training in lifesaving, resuscitation, and first aid if no lifeguard is on duty.

Before diving, make sure the water is deep enough and free of obstructions.

When swimming for distance, swim parallel to the shore or have someone accompany you in a boat.

Watch small children closely when they are in or near water.

Do not swim near diving boards or in areas where people are diving.

Never engage in horseplay in the water.

Never swim during storms.

Be sure you know water traffic regulations before sailing a boat.

Never pilot any boat without mastering the skills required to operate it safely.

Only skilled and experienced sailors should venture out alone.

Always wear a life jacket when in a boat if you cannot swim.

Only expert swimmers should water ski or skin dive, and only after receiving adequate instructions.

Hiking and Camping can be enjoyed by almost everyone. What could be more delightful than strolling in the woods, pitching a tent, and surrounding yourself with nature for a few days? Hiking and camping are easy ways "to get away from it all." The nearest woods may contain a world completely different from the world in which you live.

Although they may seem safer than some more vigorous recreational activities, hiking and camping trips are filled with hidden hazards. Some of the dangers that hikers and campers may face are wild animals, hidden streams, tree stumps, and holes in the ground. They also may lose their way in strange country. Sudden changes in weather may bring unexpected and sometimes serious hardships.

Before starting on a trip you should learn about the difficulties that may lie ahead of you. You can learn much about hiking and camping by reading books and magazines, and through such groups as the Boy Scouts and Girl Scouts, and American Youth Hostels. But once you take basic precautions, the best way to find out about hiking and camping is through experience.

If you follow these suggestions, your hiking or camping trip will be safer and more enjoyable:

Start with short trips. Work toward long, rugged trips by easy stages.

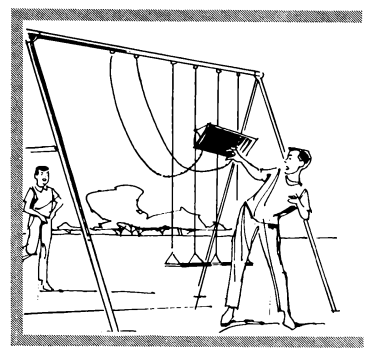
Keep as warm, dry, and comfortable as possible. Always prepare yourself for sudden changes in weather.

Choose clothing to fit the country and climate in which you will hike or camp.

Always carry sufficient changes of underclothes and socks. Have a sweater or jacket to wear when it turns cool at night.

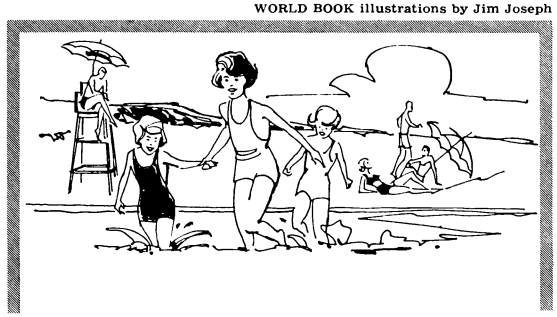
Wear sturdy shoes, and heavy socks of wool or similar material that does not hold moisture as does cotton.

Follow Playground Rules. You are responsible for the safety of yourself and others. Carelessness causes injuries.



Swim in Safe Places and never be careless in the water. Always swim near a lifeguard and remain close to shore.

WORLD BOOK illustrations by Jim Joseph



SAFETY/*RECREATION (continued)*

Never try to catch, handle, or pet wild animals. They are not pets.

Take a guide with you when you enter strange, wild country.

Know where you are going. Always carry a compass, maps, and other guides to help you find your way.

Carry a flashlight and extra batteries.

Take enough food and water for the entire trip.

Carry a first aid handbook and kit.

Winter Sports require safety precautions similar to those of most other sports. But winter sports enthusiasts must also protect against severe weather. The major dangers include thin ice, dangerous ski or toboggan slopes, inadequate training or equipment, and poor physical conditioning.

Here are some suggestions to follow:

Wear clothing that is warm, comfortable, and suited to the activity.

Be sure you have adequate equipment.

Do not attempt difficult slopes until you have developed skiing skills.

Never go beyond the skiing area unless a guide accompanies you.

Skate on supervised ice skating rinks when possible. Have ropes or planks available to help anyone who falls through the ice on natural bodies of water.

Check ice thickness on ponds or streams to make sure it is safe for skating.

Avoid skating above moving water. Varying ice thickness and strong currents make this dangerous.

Never go sledding or tobogganing on public streets, unless they have been closed off for that purpose.

Never pack snowballs with stones or ice, or to ice-like hardness.

Firearms. Serious accidents involving guns rarely occur on target ranges. People die each year in hunting accidents, but more than half of the deaths involving firearms occur at home.

A hunter safety course is recommended for all new hunters. Some states require this. Instructions in hunter safety, marksmanship, and gun safety are available from the National Rifle Association, 1600 Rhode Island Ave., NW, Washington, D.C. 20018. State rifle associations, some state departments of conservation, and a number of local shooting and hunting clubs also give instructions.

Anyone who uses firearms should follow these rules:

Learn to handle a gun safely before you use it.

Keep guns unloaded, in locked cabinets. Keep ammunition locked in a separate place.

Keep all guns away from children.

Never handle a gun without first looking into the chamber and feeling inside to make absolutely sure it is unloaded.

Always point the muzzle of a gun in a safe direction. Keep the safety catch on until you are about to shoot.

SAFETY/*TRANSPORTATION*

Motor vehicle accidents present the greatest safety problem in the United States. They cause almost half of all accidental deaths, despite constant efforts to make automobiles, highways, and drivers safer. Each year, more drivers and greater numbers of automobiles travel over the roads and highways.

Driver Education is one of the most valuable tools in traffic safety. More than 60 per cent of the high schools in the United States offer some form of driver education. In many schools the course lasts a full semester. Some schools offer less than the recommended minimum of 30 hours of classroom instruction and six hours of behind-the-wheel laboratory work. Drivers who have completed driver education courses have fewer accidents than do other drivers. See AUTOMOBILE (Driving Safely).

Pedestrian Safety. A great many motor vehicle accidents involve pedestrians. Although the driver is often at fault, many pedestrians could avoid serious injury or death by taking precautions.

Pedestrians should observe these safety rules:

Never walk on streets or highways unless there are no sidewalks to walk on.

When you must walk in streets or roads, always walk toward oncoming traffic. Step off the road whenever cars approach.

Cross streets only at intersections or in designated crosswalks. Obey traffic signals regardless of whether or not traffic is approaching.

Avoid stepping into the street away from intersections or from between parked cars. If you must do this, be extra careful.

Children should never play in streets.

Playgrounds and playing fields near streets or parking lots should be fenced in so children cannot dart out in front of cars.

Bicycles and Wheel Toys present hazards to motorists. Children riding tricycles, or using roller skates, wagons, scooters, or other wheel toys should stay on sidewalks, or in yards or playgrounds. Any cyclist not old enough to know, understand, or accept traffic regulations must not ride a bicycle in the street. See BICYCLE (diagram).

Here are some safety rules to follow:

Learn and follow the same traffic rules that automobile drivers follow.

Ride in the same direction as automobile traffic.

Stay close to the right edge of the road so cars can pass easily.

See that front and rear lights, horn or bell, and brakes are in good working order.

Always signal when turning a corner or stopping.

Slow up at intersections. Walk your bicycle across busy intersections.

Make no sudden stops or motions that might confuse a driver.

Always ride in single file when riding with a group of cyclists.

Never try stunts or ride more than one person on a bicycle.

Avoid heavy traffic. Use bicycle paths when they are available.

Children should never take wheel toys in the street. They should learn to watch for cars backing out of driveways. They should be courteous to persons using the sidewalks.

Commercial Transportation has a much better safety record than private automobiles. This is true for streetcars, buses, trains, ships, and airplanes. Operators and crews of commercial forms of transportation are trained to watch out for the safety of their passengers. In the early 1970's, passenger automobiles averaged about 2 deaths per 100 million passenger-miles (160 million passenger-kilometers). Rates for all forms of commercial transportation combined averaged less than 0.6 for the same distance.

Passengers should take the following precautions:

Follow all posted rules for safety and comfort.

Never get on or off moving vehicles.

Wait in safety zones or on curbs for streetcars or buses.

In safety zones, face oncoming traffic to remain alert to any approaching danger.

When getting off buses or streetcars, remain in the safety zone until you are sure you can cross the street safely.

Take special care when crossing in front of or behind any vehicle.

Always get into or out of taxicabs or automobiles on the curb side.

Keep your arms inside the vehicle.

Never talk to the driver of the vehicle.

Critically reviewed by NATIONAL SAFETY COUNCIL

Related Articles in WORLD BOOK include:

PUBLIC SAFETY

Civil Defense
Environmental Pollution (Controlling Pollution)
Fallout Shelter
Fire Fighting
National Safety Council
Police
Public Health
Pure Food and Drug Laws
Sanitation
Sewage
Waste Disposal

SAFETY AT HOME

Asphyxiation
Bandage
Bleeding
Botulism
Burns and Scalds
Drug (table: Rules for Using Drugs)
Emetic
Fire Extinguisher
Fire Prevention
First Aid
Insulator, Electric
Lightning Rod
Match
Mushroom (Poisonous Mushrooms)
Ptomaine Poisoning
Resuscitator
Tourniquet
Wound

SAFETY IN INDUSTRY

Coal (Mine Safety Measures)
Disease (Occupational Diseases)
Dust Explosion
Lead Poisoning
Radiation
Radiation Sickness
Radium (Dangers of Radium)
Safety Lamp
Safety Valve
Ventilation

SAFETY IN RECREATION

Artificial Respiration
Bicycle (Bicycle Care and Safety)
Boating (Boating Safety)
Camping (Camping Precautions)
Drowning
Life Jacket
Poisonous Plant
Snake Bite
Sunburn
Sunstroke
Swimming (Water Safety Rules; Lifesaving)

SAFETY IN TRANSPORTATION

Airport (Air Traffic Control)
Automobile (Driving Safely)
Aviation (Aviation Agencies and Organizations)
Coast Guard, United States
Ice Patrol, International
Radar (Law Enforcement; pictures)
Railroad (Traffic Control; Engineering Improvements)
Ship (Safety at Sea)

OTHER RELATED ARTICLES

Health
Insurance
Lightning (pictures: Lightning Safety Rules)
Protection
Weather Service, National

Outline

I. Safety/Home
- A. Falls
- B. Burns and Scalds
- C. Poisoning
- D. Asphyxiation
- E. Cuts and Scratches
- F. Safety With Electricity
- G. Other Home Hazards

II. Safety/School
- A. Corridors, Stairs, and Classrooms
- B. Gymnasiums and Athletic Fields
- C. Shops and Laboratories

III. Safety/Instruction
- A. Safety Instruction
- B. School Safety Organizations
- C. Safety Patrols and School Bus Patrols

IV. Safety/Color

V. Safety/Industry

VI. Safety/Recreation
- A. Water Safety
- B. Hiking and Camping
- C. Winter Sports
- D. Firearms

VII. Safety/Transportation
- A. Driver Education
- B. Pedestrian Safety
- C. Bicycles and Wheel Toys
- D. Commercial Transportation

Questions

Is mankind safer since natural dangers have decreased?

What proportion of injuries and deaths occur in the home? What is the most common cause of home accidents?

How are most good electrical wiring and appliances marked?

Where do the greatest number of school accidents occur? How can they be prevented?

What does an employer expect a recent graduate to have learned in school about safety?

How can reporting "the accident that almost happened" help in a school safety program?

What rules should swimmers observe?

What should be done with firearms and ammunition kept in the home?

What safety precautions should hunters observe?

What is the safe way to get on or off a bus?

SAFETY CAR. See AUTOMOBILE (The Automobile Tomorrow [picture]).

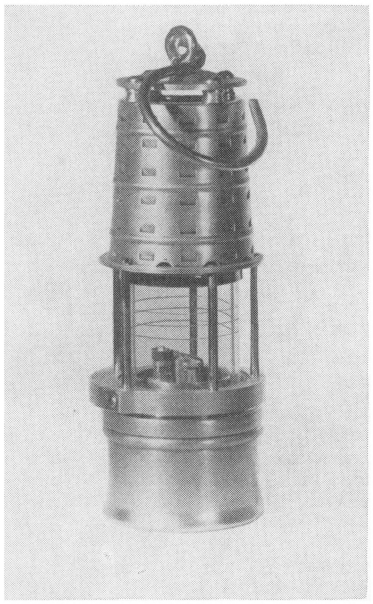
SAFETY COUNCIL, NATIONAL. See NATIONAL SAFETY COUNCIL.

SAFETY DEPOSIT BOX. See BANKS AND BANKING (How Banks Serve Us).

SAFETY GLASS. See GLASS (Specialty Glasses).

SAFETY LAMP is a lamp designed to warn coal miners of the presence of firedamp, a gas that can cause destructive explosions. Firedamp, composed chiefly of methane and air, is formed by the decay of coal.

The safety lamp burns oil. Inside the lamp a wire gauze cylinder of fine mesh forms a cage around the flame. Firedamp can be detected by lowering the wick on the lamp. If firedamp is present, a pale blue flame appears around the central flame. This warns a miner to leave the spot immediately.



Mine Safety Appliance Co., Pittsburgh

A Miner's Safety Lamp detects the presence of firedamp but will not ignite the gas that may surround it.

The heat of the flame will not pass beyond the gauze covering and light the gas on the outside until the wire becomes as hot as the flame. The wire around the miner's safety lamp has good conducting power and will not heat up before the miner has time to escape. Most safety lamps are locked to prevent miners from opening them. Some lamps go out when opened. Firedamp detectors based on electricity and light have been invented, but the safety lamp is still widely used.

The safety lamp is based on a principle discovered by the English chemist Sir Humphry Davy. Davy produced the first really successful safety lamp in 1815. GEORGE B. CLARK

See also COAL (picture: Mining in Safety); DAMP; DAVY, SIR HUMPHRY.

SAFETY MATCH. See MATCH.

SAFETY PATROL, SCHOOL. See SAFETY (Patrols).

SAFETY PIN. See PIN.

SAFETY VALVE is attached to a steam boiler to release some of the steam if the pressure becomes higher than the boiler can safely stand. It consists of a cone-shaped vent into which a plug is fitted. This plug is held in place by a lever bearing a weight. The maximum steam pressure in the boiler can be increased or decreased by shifting the weight on the lever. Many safety valves use a spring instead of a weight. This is because a spring is less subject to accident. Spring safety valves are called *pop* safety valves. The tension of the spring can be regulated so that the valve will "pop" at any desired pressure. Hot water heaters also have safety valves. OTTO A. UYEHARA

SAFFLOWER is a thistlelike plant with large heads of flowers. The blooms vary in color from white to a brilliant red. It grows about 3 feet (91 centimeters) high, and has coarse, branching stems. The broad leaves are usually spiny. The seeds must be planted each year.

The safflower has been grown in the dry areas of Asia, Africa, and Europe for hundreds of years. At one time, people used its flowers to make red dye. Today, gardeners cultivate the plant in the western United States, and in the Canadian provinces of Saskatchewan and Manitoba. Oil and meal are made from safflower seeds. The oil is used in diets for persons suffering from heart diseases and hypertension. It is also used as a drying agent in varnishes and paints. The meal is fed to livestock.

USDA

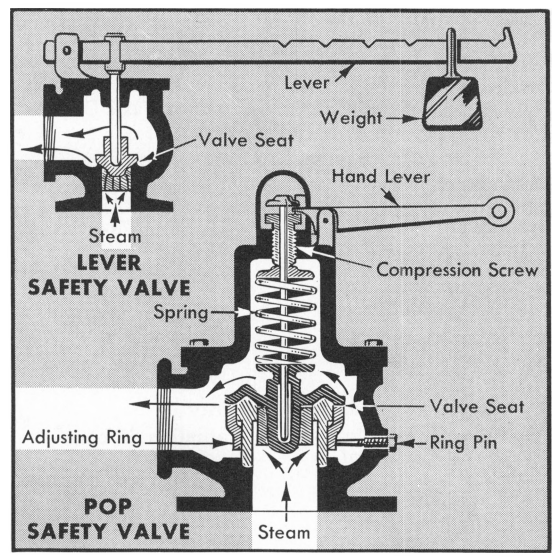
Safflower

Scientific Classification. Safflowers belong to the composite family, *Compositae*. They are classified as genus *Carthamus*, species *C. tinctorius*. HAROLD NORMAN MOLDENKE

SAFFRON, *SAF run*, is a brilliant yellow dye and a food flavoring. It is produced by drying the stigmas and part of the styles of the purple autumn crocus. About 4,000 flowers yield about 1 ounce (28 grams) of commercial saffron. Saffron has a sweet odor, but tastes bitter. It is used in cooking, and in flavoring and coloring candy. People in Europe and India use it to season various foods. See also CROCUS. LEONE RUTLEDGE CARROLL

SAGA is the name given to a large body of literature written in Iceland between the 1100's and the 1300's. The word *saga* is related to the Icelandic verb meaning "to say" or "to tell." Any story—especially an adventure story—may be called a saga.

The earliest sagas were biographies of Icelandic bishops and Norwegian kings. The greatest achievement in this early historical writing was a complete history of



the Norwegian kings composed by Snorri Sturluson in the 1200's. About 40 of the estimated 400 Icelandic sagas have been preserved.

The classic sagas were composed in the 1200's. They are usually known in English as *Icelandic Family Sagas* and in Icelandic as *Sagas of Icelanders*. They are anonymous and vary in length from short stories to full-length novels, and were composed in a concise but highly expressive style. Scholars once believed these sagas were transmitted orally from generation to generation until scribes wrote them down in the 1200's. However, most scholars now believe the sagas were conscious artistic creations, based on both oral and written tradition.

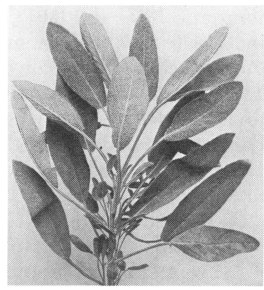
The sagas were composed during a period of civil war and social decline. They glorified the moral and social codes of a "golden age" that occurred between 850 and 1050 during the early settlement of Iceland. They are tales of legal disputes and blood vengeance, and provide a detailed picture of social and cultural conditions at that time. The longest and finest is *Njal's Saga*, a tale of honor and loyalty, death and vengeance.

During the 1200's, the European literature of chivalry began to influence Icelandic writers. Sagas became more romantic and fantastic. By the early 1300's, the nature of sagas had completely changed. These later sagas described the adventures of many traditional Germanic heroes such as Sigurd the Dragon Slayer and Rollo. Generally, critics consider these sagas inferior to the earlier ones. KENNETH G. CHAPMAN

See also SNORRI STURLUSON; SIGURD.

SAGE. See AIR FORCE, UNITED STATES (Defense).

SAGE is a somewhat shrubby garden plant known for its sweet odor and the flavor of its leaves and stems. It came from the southern part of Europe, and gardeners grow it throughout North America. Sage stands from 6 to 15 inches (15 to 38 centimeters) high. It has rough, woolly, grayish-green leaves, and a white, woolly stem. The flowers may be blue, white, or purple. They grow in groups. The sage is reproduced by seeds or by planting slips or cuttings. It needs much sun and rich soil. Cooks use the leaves and stems of the sage in making seasonings for sausages and cheeses, dressings for meat, and sauces. There are also several other species of wild and cultivated sage.



J. Horace McFarland

Sage

Scientific Classification. Sage belongs to the mint family, *Labiatae*. Garden sage is classified as genus *Salvia*, species *S. officinalis*. HAROLD NORMAN MOLDENKE

SAGE, RUSSELL (1816-1906), was an American banker and philanthropist. He served two terms as a Whig member of the House of Representatives in the 1850's. Later, he joined Jay Gould, the railway promoter, and made a fortune in railway promotions and in stocks (see GOULD [Jay]). Sage was born in Oneida County, New York.

Margaret Sage (1828-1918), his second wife, used his fortune in many projects (see SAGE FOUNDATION, RUSSELL). She left money to 18 colleges, including Russell Sage College. Mrs. Sage also bought 70,000 acres (28,000 hectares) on Marsh Island, in the Gulf of Mexico off the coast of Louisiana, for a bird refuge. She also made bequests to the American Museum of Natural History and the Metropolitan Museum of Art, both in New York City. V. E. CANGELOSI and R. E. WESTMEYER

SAGE FOUNDATION, RUSSELL, is an institution whose chief aim is to remove the causes for poverty and allow people to earn enough to have sanitary homes, wholesome food, and healthy children. The foundation was incorporated in 1907 by the widow of Russell Sage, who gave an endowment of $10 million for the improvement of social and living conditions in the United States. Soon afterward the endowment was increased by $5 million. For assets, see FOUNDATIONS (table).

The foundation includes a research program, a welfare organization, a department that promotes new ways of helping needy and retarded children, a child-hygiene department, and a housing project for persons with low incomes. It conducts its activities directly under its own auspices or jointly with selected organizations. It does not relieve directly either individual or family needs. Headquarters are at 230 Park Avenue, New York, N.Y. 10017. CARTER ALEXANDER

SAGE OF MONTICELLO. See JEFFERSON, THOMAS (The Sage of Monticello).

SAGEBRUSH is a bushy plant known for its sweet odor and bitter taste. The sagebrush grows in the dry plains of the western part of the United States, particularly in northeastern California, eastern Oregon, Nevada, Utah, Wyoming, and Colorado. It may grow to any height from 2 to 12 feet (0.6 to 3.7 meters), and has a straight stiff stem. The leaves are small and grow close together. The flowers of the sagebrush grow at the top of the stem, and may be yellow or white. Each flower is made up of many tiny flowers called *florets*.

The sagebrush is a perennial. It flourishes in the dry soil of the western plains, where many other plants cannot grow. But it also grows on mountain slopes. Sometimes the heat and dryness in the summer dry up the plant so much that it shows no sign of being alive. Then, the wind often uproots the sagebrush and blows it all over the plains, much as the wind blows tumbleweed. The seeds of the sagebrush are scattered in this way. Often the sagebrush is the only plant life for great distances.

Sagebrush is not true sage, a plant used widely for seasoning (see SAGE). Sagebrush received its common name from the sweet, sagelike odor of its crushed foliage. There are several types of sagebrush. Some are used as food for sheep in the winter. Some people use sagebrush for fuel, because the dry wood burns with a hot flame and gives off a sweet-smelling smoke. Sagebrush can also be cultivated for domestic gardens.

Scientific Classification. Sagebrush belongs to the composite family, *Compositae*. The common sagebrush is genus *Artemisia*, species *A. tridentata*. J. J. LEVISON

See also NEVADA (color picture: State Flower).

SAGEBRUSH STATE. See NEVADA.

SAGINAW, *SAG uh naw*, Mich. (pop. 91,849; met. area 219,743), is a manufacturing city with about 220 industrial plants. The city stands beside the Saginaw River, about 85 miles (137 kilometers) northwest of De-

troit and about 20 miles (32 kilometers) south of Saginaw Bay. See MICHIGAN (political map).

Farms near Saginaw produce large crops of sugar beets. Sugar processing and shipping is a major industry in the Saginaw area. The city also has one of the world's largest bean elevators. Products include automobile parts, boilers, furniture, graphite products, machinery, measuring instruments, railway equipment, and venetian blinds. Saginaw, with nearby Midland, is an important producer of chemicals. The city has about 160 wholesale firms.

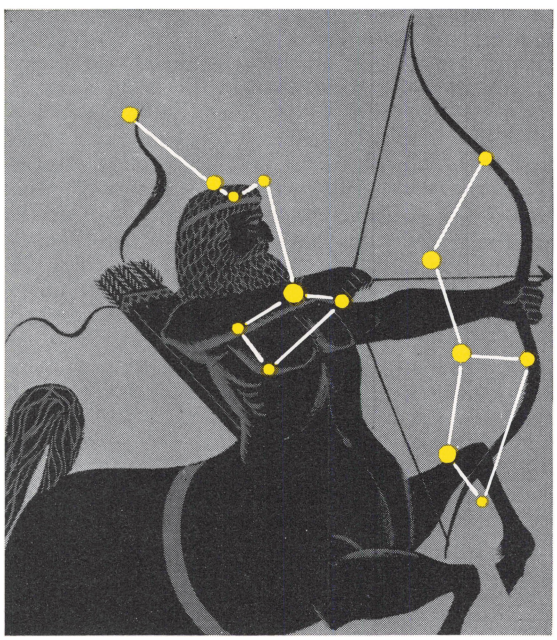
Large ships can sail down the Saginaw River from the city to the mouth of Saginaw Bay. The city has an airport, and freight railroad and bus service.

A settlement called Saginaw was founded on the west bank of the river, following the building of Fort Saginaw about 1820. A second settlement, called East Saginaw, began on the opposite bank in 1849. The two united as Saginaw in 1889. Fur trading flourished until the first sawmill was erected in 1834. Saginaw became a lumber center until most commercially valuable Michigan forests were cut down in the late 1800's.

Saginaw was never incorporated as a village. It received a city charter in 1857. The city is the seat of Saginaw County, and has a council-manager form of government. WILLIS F. DUNBAR

SAGITTARIUS, *saj ih TA rih us*, THE ARCHER, is a *constellation* (group of stars) located in the Milky Way. It is the ninth sign of the zodiac (see ZODIAC). Sagittarius has no bright stars, but it can be seen in the southern part of the sky in late summer. The sun, the earth, and Sagittarius are in a straight line in the sky on December 22, the beginning of winter.

In Greek mythology, the constellations Sagittarius and Centaurus were placed in the sky to honor Chiron, the wise *centaur* (mythical half-man, half-horse). See also ASTRONOMY (Skies of the Seasons); CENTAURUS. I. M. LEVITT



The Constellation Sagittarius, the Archer

SAGO, *SAY goh*, is a starch found in the spongy center, or pith, of various tropical palm trees. A type of flour, called *sago flour*, is made from sago. The largest supply of sago comes from the East Indies. Large quantities of sago are sent to Europe and North America for cooking purposes. Sago flour is used mostly in making puddings and as a thickening for soups. The flour is nourishing and easy to digest. Sago is one of the principal foods of East Indian people.

The fruit of the palm trees from which sago is produced is not allowed to ripen fully. The full ripening completes the life cycle of the tree and exhausts the starch center. It leaves the trunk a hollow shell and causes the tree to die. Workers cut down the palms when they are about 15 years old, at which time they are just ready to flower. The stems, which grow 30 feet (9 meters) high, are split up. The starch pith is taken from the stems and ground to a powder. A single palm yields about 800 pounds (360 kilograms) of starch. The powder is kneaded in water over a cloth or sieve. It passes into a trough where it settles. After a few washings, the sago flour is ready to be used in making puddings and soups. Sago is further refined and prepared for export. LEONE RUTLEDGE CARROLL

See also ARROWROOT; CORNSTARCH; TAPIOCA.

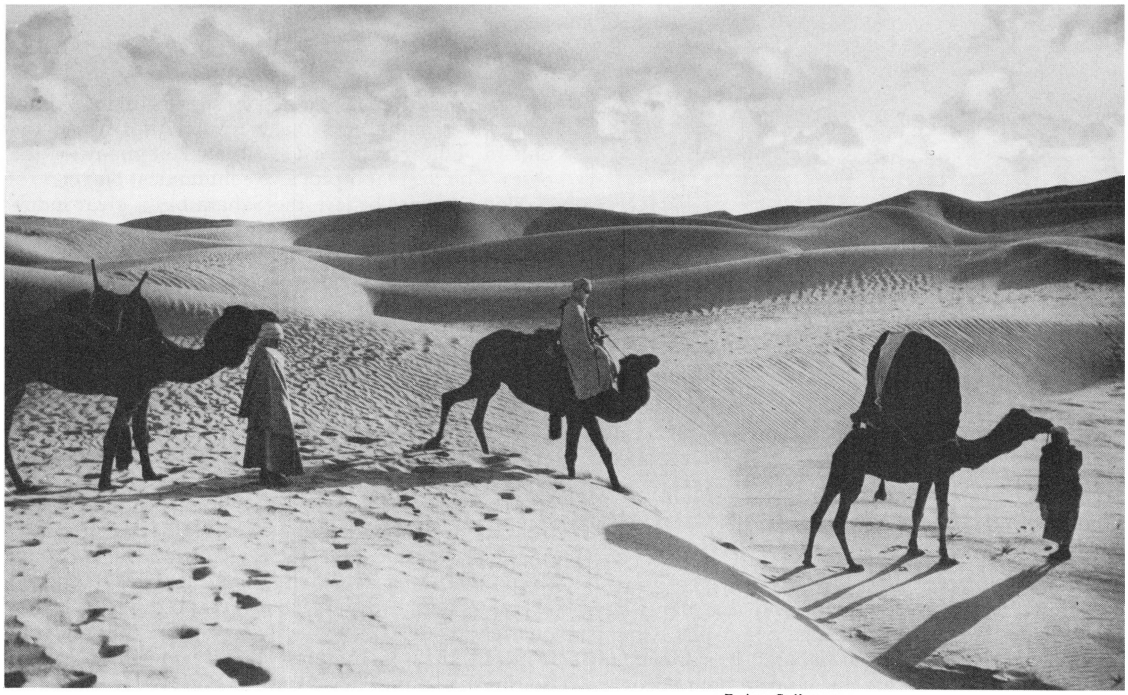
SAGUARO, *suh GWAH roh* or *suh WAH roh*, is the largest cactus of the United States. This huge plant, often called the *giant cactus*, may stand more than 50 feet (15 meters) tall and weigh as much as 10 short tons (9 metric tons). It grows only in the foothills and deserts of southern Arizona, southeastern California, and northwestern Mexico. The saguaro is the state flower of Arizona.

The saguaro has a columnlike trunk that measures from 1 to $2\frac{1}{2}$ feet (30 to 76 centimeters) in diameter. The plant also has a few large, upturned branches. Grooves and *ribs* (ridges) run lengthwise along both the trunk and branches. Little rain falls in the region where the saguaro grows. The plant soaks up and stores large amounts of water after the rare showers that do occur. The grooves and ribs of the saguaro expand and contract, much like an accordion, depending on the amount of stored water.

Padlike structures called *areoles* grow along the ribs. Each areole has from 15 to 25 long spines. The branches of the saguaro grow from certain areoles on the trunk. During May and June, the areoles near the tip of the trunk and branches produce waxy, greenish-white flowers. These funnel-shaped flowers measure 3 or 4 inches (7.6 to 10 centimeters) long and bloom at night.

Bats, birds, and insects gather nectar from saguaro blossoms and, during the process, spread pollen from flower to flower. The pollinated flowers may then produce purplish-red, egg-shaped fruit. The mature fruit splits open, exposing watermelon-red pulp filled with black seeds. Many desert creatures eat the ripe fruit. The Indians of the region also eat the raw fruit or use it to make preserves and syrups.

Scientific Classification. The saguaro belongs to the cactus family, *Cactaceae*. Many botanists classify it as genus *Cereus*, species *C. giganteus*. Others classify it as *Carnegiea gigantea*. DONALD J. PINKAVA



Ewing Galloway

A Camel Caravan slowly plods across the shifting sand dunes of the Sahara. Such "ships of the desert" have provided transportation across the world's largest desert for hundreds of years.

WORLD BOOK map

Location of Sahara

See also ARIZONA (pictures: The State Flower, Giant Saguaro Cactus); CACTUS; TREE (picture).

SAGUARO NATIONAL MONUMENT is in southern Arizona near Tucson. It is named for the saguaro cactus, which may grow 50 feet (15 meters) high and weigh 10 short tons (9 metric tons). The 78,986-acre (31,964-hectare) monument was established in 1933. Its wildlife includes the coyote, black bear, and elf owl. See also ARIZONA (picture).

SAGUENAY RIVER, *sag uh NAY*, is an important waterway in the Canadian province of Quebec. This river begins at the eastern end of Lac Saint-Jean in Quebec. It flows eastward for about 100 miles (160 kilometers), and empties into the St. Lawrence River about 120 miles (193 kilometers) northeast of the city of Quebec (see QUEBEC [physical map]).

The Saguenay River is not navigable for its first 35 miles (56 kilometers). It drops more than 300 feet (91 meters) in this stretch, which extends from Lac Saint-Jean to Chicoutimi. However, this upper branch of the Saguenay has been harnessed for a power output of more than 1 million kilowatts.

The Lower Saguenay begins just below Chicoutimi, where the river forms a small inlet called Ha Ha Bay. The chief harbors on Ha Ha Bay are Port Alfred for industrial traffic, and Bagotville for passenger ships. The Lower Saguenay is navigable for the 65 miles (105 kilometers) from Chicoutimi to the St. Lawrence River. It becomes a fiord in this stretch, averaging 800 feet (240 meters) deep. Cape Trinity and Cape Eternity, the most famous of the river's cliffs, tower over the Lower Saguenay. Both cliffs are more than 1,600 feet (488 meters) high.

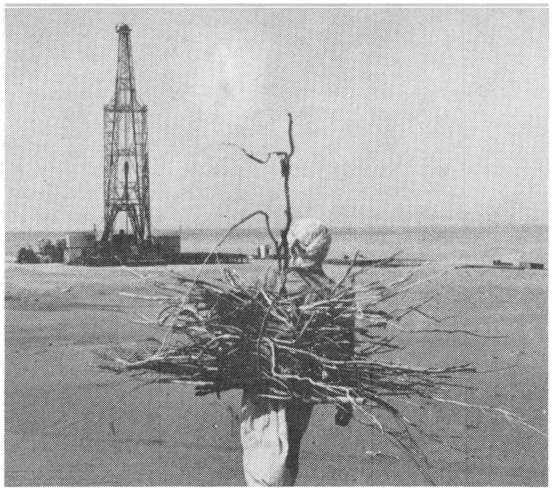
Tourist cruises have been conducted on the Saguenay River since 1849. The Saguenay is a major lumber-transportation route. Tadoussac, at the mouth of the river, is a well-known resort area. MURRAY G. BALLANTYNE

SAHARA is the largest desert in the world. It stretches across North Africa from the Atlantic Ocean to the Red Sea, and from the Mediterranean Sea to the Sudan. It combines with the Sudan in a zone of steppe vegetation. Only a narrow strip of fertile land along the Nile River and scattered *oases* (places where palms and grasses grow) break up this vast desert land. *Sahara* means *desert region*.

The Sahara is almost as large as the United States. It covers about 3 million square miles (8 million square kilometers). Its greatest length, from east to west, is about 3,200 miles (5,150 kilometers), or greater than the distance between New York City and San Francisco, Calif. The Sahara is from 800 to 1,400 miles (1,300 to 2,250 kilometers) wide from north to south.

The Sahara covers most of Algeria, Libya, and Egypt, and parts of Morocco, Tunisia, and the Sudan. This vast desert also includes large parts of Chad, Niger, Mauritania, and Mali, and Spanish Sahara, a Spanish province in Africa.

Part of the Sahara has hot, shifting sand dunes. But other parts have a hard and rocky surface. A central plateau extends about three-fourths of the distance across the desert from northeast to southwest. This plateau is from 1,900 to 2,500 feet (579 to 762 meters) above sea level. Three mountain ranges, the Ahaggar, the Tibesti, and the Aïr, rise above this plateau. The highest peaks are from 6,000 to nearly 10,000 feet (1,800 to 3,000 meters) above sea level. Many fertile river valleys lie in this region. The western Sahara is a vast sand waste. The Libyan Desert, north and east of the central plateau, is a gravelly waste.



Boubat, Photo Researchers

A Sahara Nomad carries dry wood for a campfire. An oil derrick, *background,* rises from the sand and stones.

Climate. The northeast trade wind that blows constantly across Africa from the Red Sea to the Atlantic dries up the moisture of the Sahara. In summer, the equatorial sun often pushes the temperature to between 120° F. (49° C) and 130° F. (54° C) during the day. In winter, the sand cools so quickly that there may be frost during the night. The temperature falls quickly when the wind becomes cutting and cold. It seldom snows in the lower areas of the desert but higher mountains are sometimes snow-covered. Sandstorms often occur.

All parts of the Sahara get some rain, but in many places there are only a few scanty showers. Sometimes rain falls, but evaporates before it strikes the ground.

Oases are watered spots in the desert. There are many of these areas in the Sahara. Some cover less than 1 square mile (2.6 square kilometers), but others are so large that several million date palms may be grown by the use of irrigation. Most of the oases are watered by springs that are fed from underground water. This water collects on a layer of clay beneath the sand. Some oases have been enlarged by digging new wells.

Animal Life is scarce on the Sahara, because of the small natural food supply. The camel and the ostrich find a natural environment in the sandy wastes. On the borders of the desert, where there is some water, there are lions, panthers, hyenas, jackals, foxes, and several kinds of apes. There are many snakes.

The People of the Sahara include Arabs, Berbers, Tibbu, and Negroes. They have fitted their way of life to the desert conditions. The Arabs and Berbers live along the northern border of the desert near the Mediterranean Sea. The wandering Arabs of the desert are often called Bedouins. Bands of Berbers called Tuaregs wander over the middle Sahara. The Tibbu are a Negro people of mixed ancestry who live in the southeastern part of the desert. Negroes inhabit the southern section of the Sahara. Most of these people follow the Islamic faith. See ARAB; BEDOUINS; BERBERS.

Industry and Trade. Camel caravans have crossed the Sahara desert since very early times. There is some evidence that the caravan routes are about 4,000 years old. But thirst and starvation, sandstorms, or attack by bandit tribes often threatened those who attempted to cross the desert before the motor truck was developed. In 1923, the French government sent track-type tractors across the width of the Sahara for the first time. Today, motorbuses and trucks make regular trips across the Sahara. Filling stations are situated at many of the oases. The telegraph provides communication.

Many persons believe the Sahara has a great industrial future. Natural resources which have already been discovered in commercial quantities in the rocky regions of the Sahara include oil, uranium, iron ore, coal, copper, and phosphate. France used the Sahara for nuclear bomb tests in the 1960's. ELDRED D. WILSON

Related Articles in WORLD BOOK include:

Camel	Harmattan	Oasis	Sirocco
Desert	Libyan Desert	Simoom	

SAID PASHA. See DE LESSEPS, FERDINAND M.

SAIGON, *sy GAHN* (pop. 1,761,335), is the capital of South Vietnam and the largest city in Indochina. It is Vietnam's largest port and the center of commerce and industry in South Vietnam. For location, see VIETNAM (map). Saigon has been the South Vietnamese capital since 1954, after an international agreement divided Vietnam into two parts. Saigon served as the headquarters of the United States forces in the Vietnam War. In 1975, Communist forces won full control of South Vietnam. They renamed Saigon *Ho Chi Minh City* in honor of the former president of North Vietnam.

Tree-lined boulevards beautify the center of Saigon and of Cholon, a largely Chinese section of the city. Saigon has much modern architecture, which contrasts with the city's many Chinese and French-colonial buildings. The University of Saigon has over 40,000 students and is the largest institution of higher learning in Vietnam.

Saigon lies near the Mekong River Delta, a fertile agricultural region of Vietnam. Before 1957, Saigon served mainly as a port for the export of rice and rubber. Today, the city produces cement, pharmaceuticals, and processed food.

In the 1700's, Vietnamese who had migrated from the north used Saigon as a port to ship back rice grown in the Mekong River Delta. The French took control of Saigon in 1861 and used it as a military base. Until 1949, Saigon was the administrative capital of Cochin China, a part of French-controlled Indochina. France approved limited independence for Vietnam that year, and Saigon became the capital. Communist rockets and mortars caused some damage in the city during the Vietnam War. DENNIS J. DUNCANSON

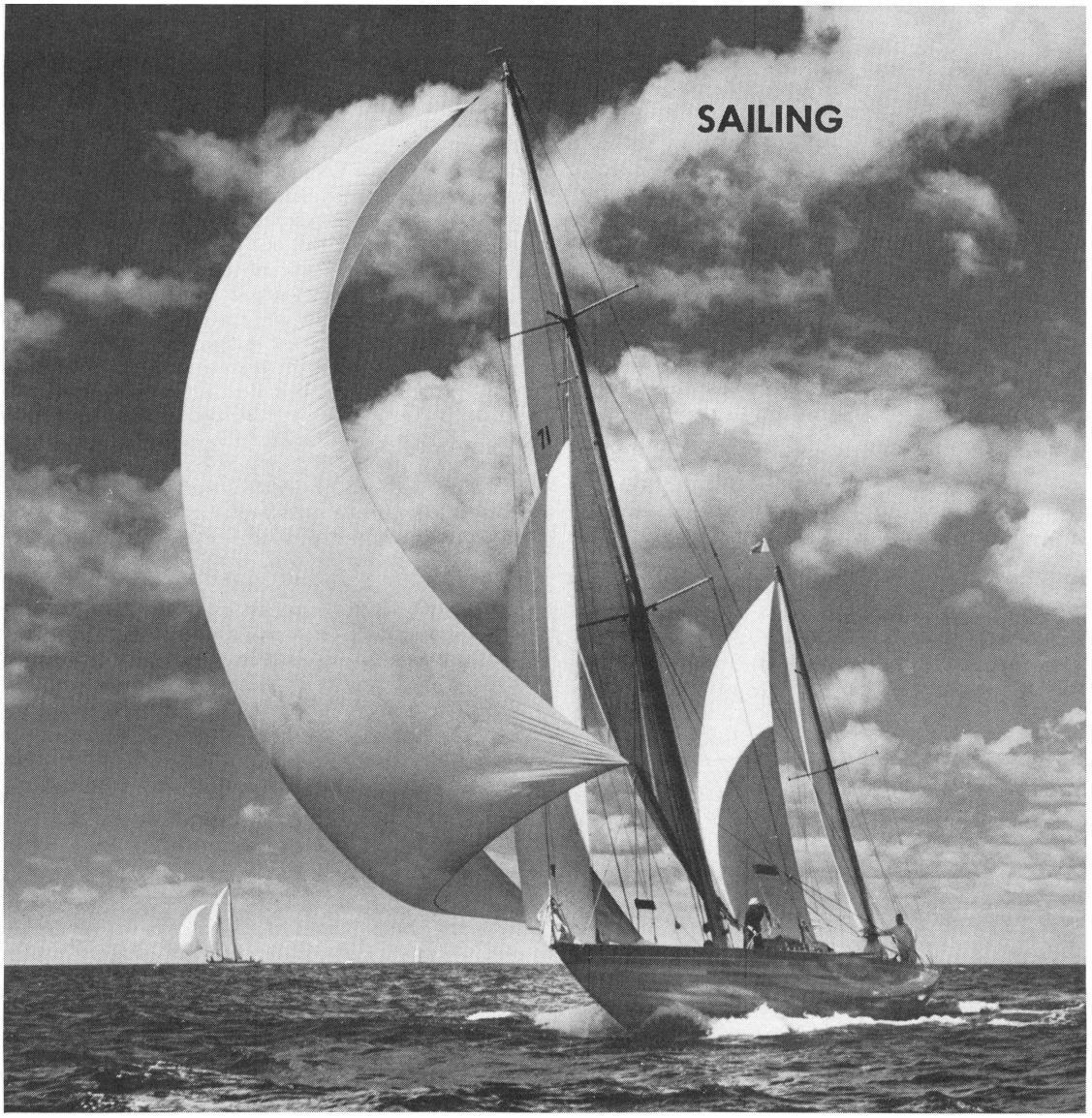
SAIGON RIVER. See MEKONG RIVER.

SAIL. See SAILING; SHIP; SHIP, MODEL.

SAILFISH is a large fish that has a large dorsal fin that spreads out like a sail. Sport fishermen catch these game fighting fishes on light rod-and-reel tackle in the warm ocean waters off both U.S. coasts, and Central and South America. Sailfish around Florida are sometimes 6 feet (1.8 meters) long and weigh 120 pounds (54 kilograms). The largest caught in Pacific waters weighed 221 pounds (100 kilograms). The flesh is good to eat. The upper jaw is sharp and long, like that of the swordfish, to which it is related. Sailfish are sometimes called *billfish.*

Scientific Classification. The sailfish belongs to the marlin family, *Istiophoridae.* It is genus *Istiophorus,* species *I. platypterus.* LEONARD P. SCHULTZ

See also FISH (picture: Fish of Coastal Waters and the Open Ocean).



Morris Rosenfeld

SAILING is an exciting water sport. The thrill of sailing a boat in a fresh breeze attracts thousands of sailors to seashores, lakes, and rivers in all parts of the world. They take to the water in sailboats that range in size from tiny dinghies to large yachts that can cross an ocean. Many persons enjoy racing their boats against other craft. For some, sailing brings the pleasure of leisurely hours on the water. All sailors love the challenge sailing offers to their skill as seamen.

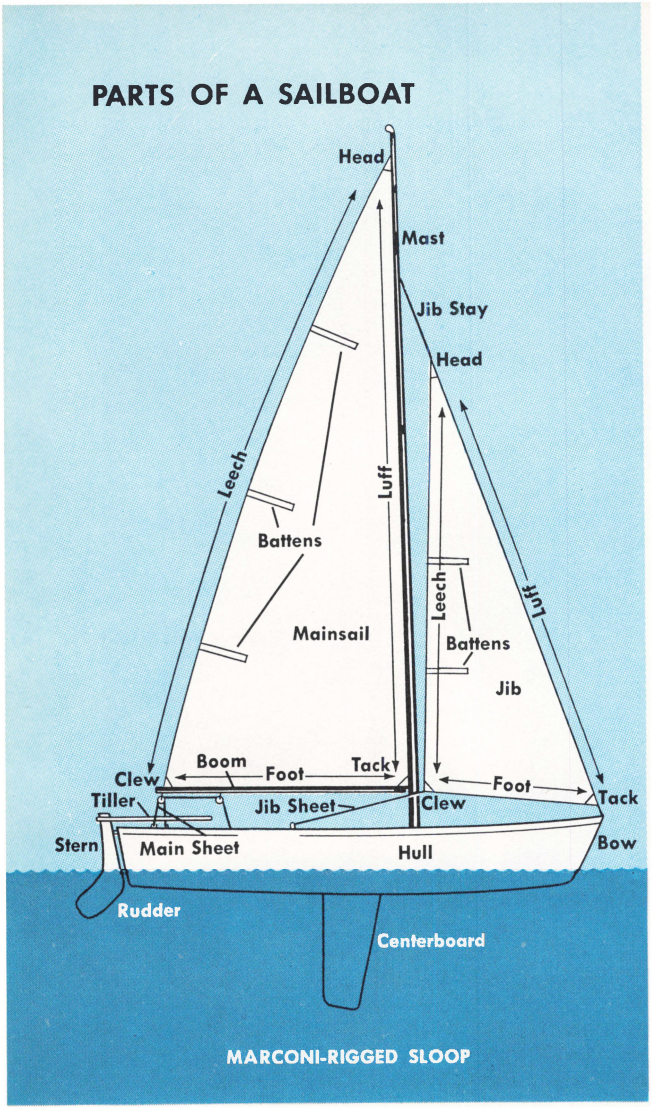
For hundreds of years, all great navies and merchant fleets consisted of sailing vessels. Tall-masted ships with huge, billowing canvas sails traveled to all parts of the world. By the early 1900's, steamships had almost completely replaced sailing vessels for military and commercial purposes (see SHIP [Sailing Ships in the 1900's]). The development of sailing as a sport began when sailing ships declined in commercial importance.

Professional boatbuilders make most pleasure sailboats. Many boats have hulls made of wooden planking fastened over frames. But newer materials, such as fiberglass and molded plywood, have become increasingly popular. Many amateurs build small sailboats at home. Sometimes manufacturers supply the parts in a kit, and the buyer simply fits them together. This is an especially popular way of building small boats called *prams*. These boats are 8 feet (2.4 meters) long and have blunt ends similar to the baby carriages known as prams. They are the smallest practical sailboats and are excellent for new sailors learning sailing fundamentals.

The Parts of a Sailboat

Each part of a sailboat has a special name. Sailors everywhere take great pride in using the proper terms. The main parts of a sailboat include (1) the hull, (2) the spars, (3) the sails, and (4) the rigging.

Hull is the body of a sailboat. The front of the hull is called the *bow*, and the rear is called the *stern*. *Forward*, or *fore*, means *front*, and *aft* means *rear*. Almost all sailboats have either a *keel* or a *centerboard*. These flat pieces of metal or wood extend into the water from the bottom of the hull to prevent movement to either side. A keel is fixed in place. But a centerboard can be raised or



lowered through a slot in the bottom of a hull. Some boats, such as inland scows, may have two centerboards known as *bilge boards*. Other craft, such as sailing canoes, have *leeboards*, one on each side of the hull. Bilge boards and leeboards serve the same purpose as keels and centerboards. A crewman steers the boat with the *rudder*, a flat piece of metal or wood that extends vertically into the water near the stern of the boat. On small sailboats, he turns the rudder with a long handle called a *tiller*, and on larger boats with a *wheel*.

Spars are the poles that support the sails. They include masts, booms, and gaffs. *Masts* are the upright poles that hold the sails. The *mainmast* holds the largest sail. Some large sailboats also have a shorter mast, called a *mizzenmast*, toward the stern, or a shorter *foremast* toward the bow.

Booms and *gaffs* are the poles that extend at right angles to the masts and hold the sails straight out. Booms are fastened to the bottom of the sail, and gaffs are fastened to the top. Few pleasure or racing sailboats used in the United States today are *gaff-rigged* (have sails hung from a gaff). Nearly all American sailboats are *Marconi-rigged*, with triangular sails held out at the bottom by a boom. They received this name because the tall masts necessary to hold these sails looked like the antennas for the radio developed by the Italian electrical engineer Guglielmo Marconi.

Nearly all pleasure and racing boats are also *fore-and-aft-rigged*. One end of the boom or gaff is joined to the mast and holds the sail out backward from the mast and parallel to the length of the boat.

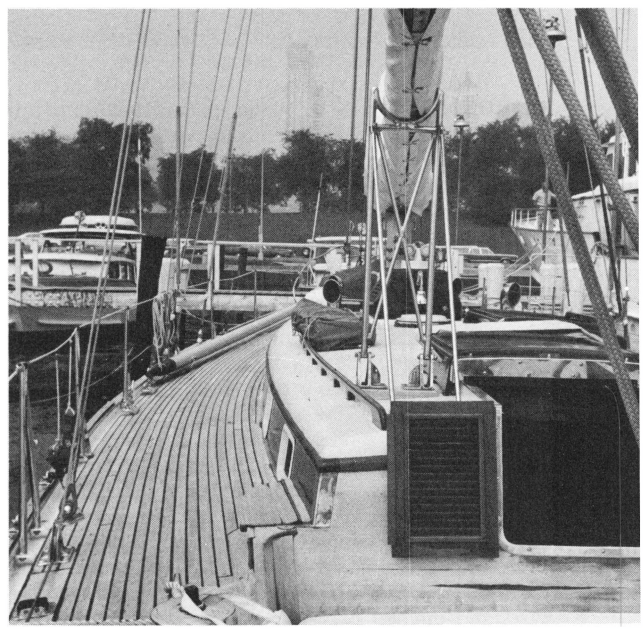
Sails. The *mainsail* (largest sail on a sailboat) is fastened to the back of the mainmast. A smaller, triangular sail in front of the mainmast is called a *jib*. A large jib that overlaps the mast and stretches far back next to the mainsail is called a *Genoa jib*, after the Italian port where it was first used. The *spinnaker* is a large, balloon-shaped sail used for added speed when a boat sails with the wind. Spinnakers are often made in red, blue, and other bright colors. Dacron has largely replaced cotton as a material for sails. This material is strong and tightly woven, and holds its shape well no matter how strong the wind blows. But spinnakers are usually made of nylon, which is strong, light, and elastic. Nylon is too elastic for regular sails.

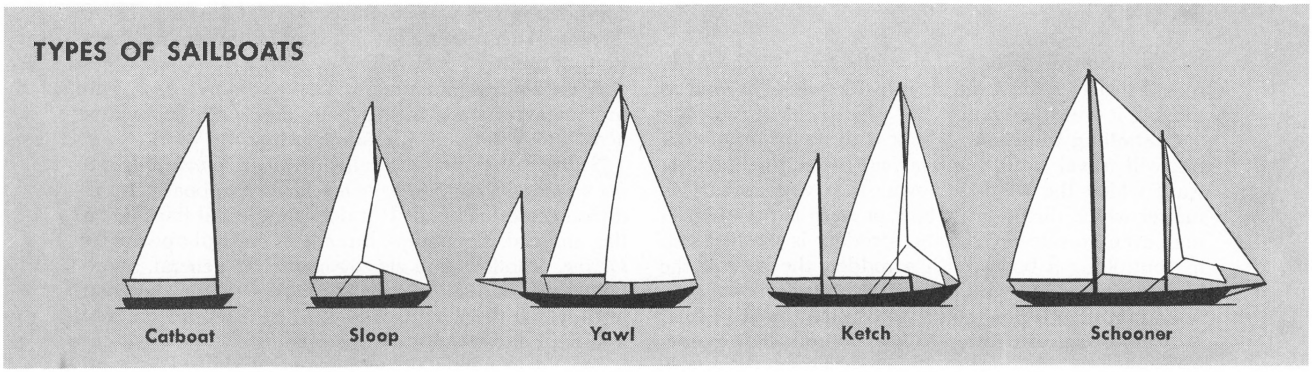
Rigging includes the *lines* (ropes) used on a sailboat. *Standing rigging* is permanent and supports the masts. It includes *shrouds* that run from the sides of the boat to the mast, and *stays* that run from the bow to the mast. *Running rigging* consists of the lines used to adjust the sails and booms. The lines that raise and lower the sails are called *halyards*. Those used to *trim* (adjust) the sails are called *sheets*.

Kinds of Sailboats

Sailboats are classified according to their size and the way their sails and masts are *rigged* (arranged). There are many combinations of sails and masts. The most common rigs include catboats, sloops, yawls, ketches,

Skipper's View of a Sailing Sloop. The boom, *top*, extends back overhead from the mast. The doorway leads to the cabin.
Robert E. Mann





and schooners. Most small sailboats are catboats and sloops. Larger sailboats, especially those capable of ocean trips, are usually yawls, ketches, or schooners.

Catboats and Sloops, the most popular sailboats, are easy to sail and comparatively cheap. A *catboat* has one mast far forward in the bow, and only one sail. One type of small catboat especially popular with children is called a *sailing dinghy*. A *sloop* has one mast toward the middle of the boat, and two sails, a mainsail and jib. A large sloop with two jibs is sometimes called a *cutter*. *Inland scows* are popular on lakes. These light, fast boats are usually sloop-rigged. They have a rounded bow and a square stern, and are flat-bottomed. Scows usually have two bilge boards and two rudders.

There are several hundred classes of catboats and sloops. Each is built slightly differently as to the design and size of its hull, sails, and rigging. These sailboats are known as *one-design* classes. That is, all the boats in a particular class are built to exactly the same measurements. Each class has its own name, such as *Snipe*, *Penguin*, *Lightning*, and *Star*. The *Snipe* ranks as the world's most popular sailboat, with more than 10,000 boats registered in about 25 countries.

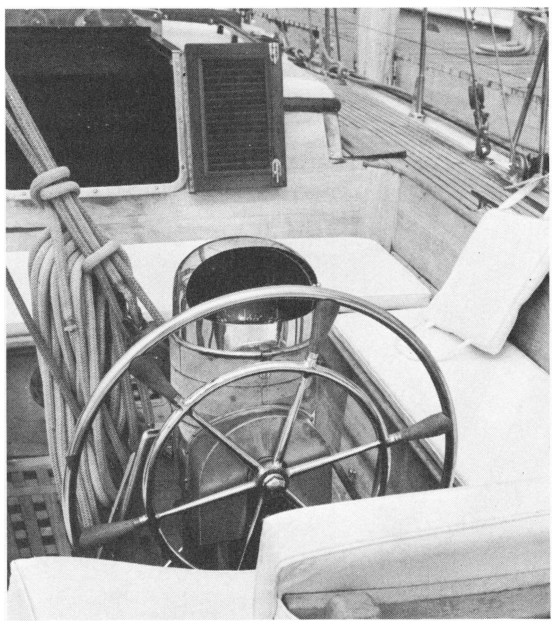
Yawls, Ketches, and Schooners are large, expensive boats. All have two masts and may be over 70 feet (21 meters) long. A *yawl* has at least three sails—a jib, a mainsail, and a mizzensail. The mizzenmast stands in the stern behind the rudder post. A *ketch* also carries three or more sails, but the mizzenmast stands in front of the rudder post. A *schooner* has a mainmast in about the middle of the boat and a foremast. A schooner has the most sails, including one or more jibs, a foresail, and a mainsail. These larger boats may have comfortable living quarters that make them popular for long trips. If they have engines to help them sail into and out of harbors, they are called *sailing auxiliaries*.

Sailing a Boat

Even a log raft with a goatskin tied to a pole will sail before the wind. To sail in other directions, a boat must

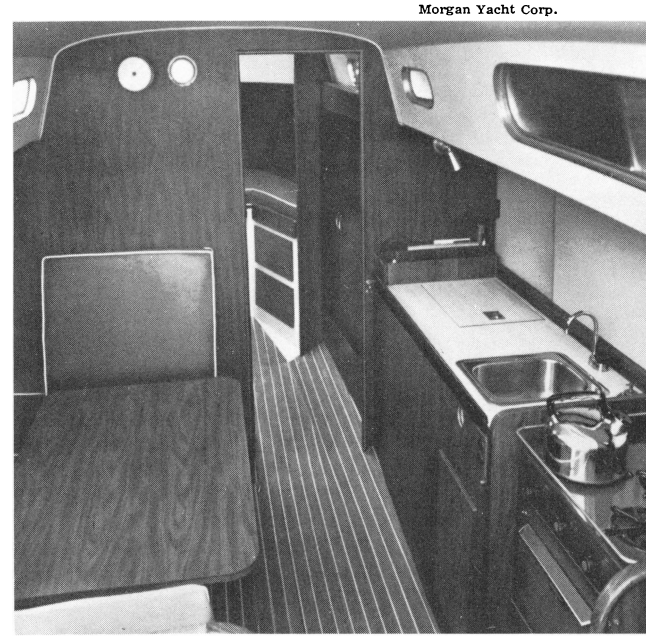
The Wheel is used to turn the rudder and steer the sailboat. Lines near the wheel *trim* (adjust) the mainsail.

Robert E. Mann



The Galley **(Kitchen)** makes up part of the boat's cabin area. Sleeping quarters are beyond the door in the front of the cabin.

Morgan Yacht Corp.



be designed and rigged so that the force of the wind moves it across the wind or into the wind, as well as moving it with the wind.

Controlling Direction. A boat with no means of control will travel straight *downwind* (in the direction toward which the wind is blowing). It will do this no matter which direction its bow or stern is pointing. It may even go sideways. Using a rudder is the first step in controlling a boat. With a rudder, the bow of the boat can be pointed in the desired direction.

But a rudder is not enough to control a boat. A boat must also have something to keep it from sliding sideways when moving across the wind. This is done with a keel, centerboard, bilge boards, or leeboards. Boats with keels can sail only in water deeper than the keel. Boats with centerboards and bilge boards can sail in shallower water, because the centerboard or bilge boards can be raised or lowered as needed. Leeboards are a simple way of changing a canoe or rowboat into a sailboat. They can be swung out of the water when not needed.

With a rudder for steering and a keel or centerboard to prevent sideward movement, a sailboat can travel in many directions. The bow of a sailboat is usually sharply pointed, so it can cut through the water easily.

Why a Boat Sails. A sail has curved edges so it will be shaped like the wing of an airplane when the wind fills it out. The side of the sail to *leeward* (away from the wind), corresponds to the top of an airplane wing. The action of the wind blowing across this curved surface creates a lift similar to the force that enables an airplane to stay in the air (see AERODYNAMICS). In a sailboat, this lifting force becomes a pull away from the sail and toward the bow of the boat. At the same time, the wind also exerts a push against the other side of the sail. In this way, the action of the wind on the sail combines in two ways to force the boat forward. These forces make it possible to sail a boat in almost any direction, no matter which way the wind is blowing.

Basic Sailing Maneuvers. There are three basic sailing maneuvers: (1) sailing into the wind, (2) sailing across the wind, and (3) sailing before the wind.

Sailing into the Wind is called *tacking to windward*, *sailing on the wind*, or *beating to windward*. No boat can sail directly into the wind. If it does so, the sail flaps like a flag and becomes useless. But a boat can sail upwind by *tacking*, or following a zig-zag course. In general, a sailboat can head to within 45 degrees of the direction from which the wind is blowing before its sail starts to *luff* (flap) and lose its driving force.

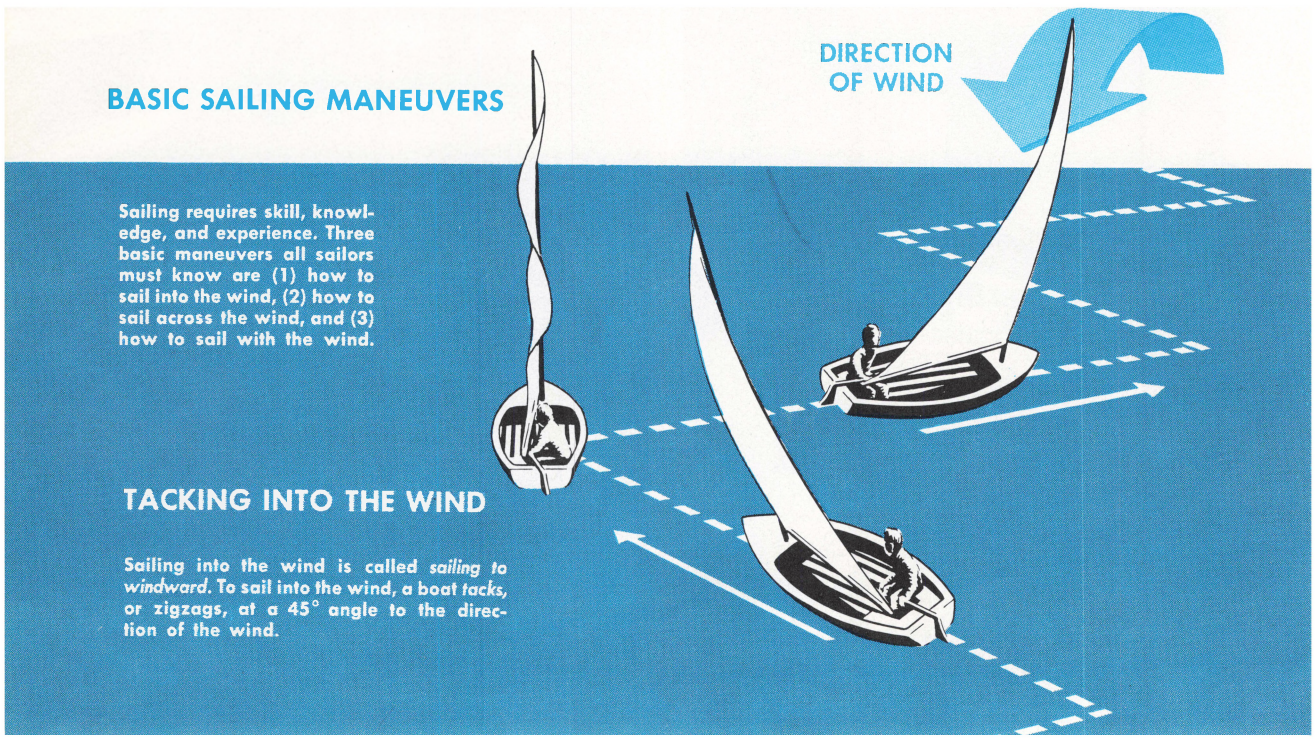
Sailing to windward requires great skill. The wind almost never blows constantly with the same force from the same direction. The speed with which a sailor's tacks bring him to a certain point upwind depends on his ability to feel the little shifts and changes in the wind, and to adjust his sails accordingly.

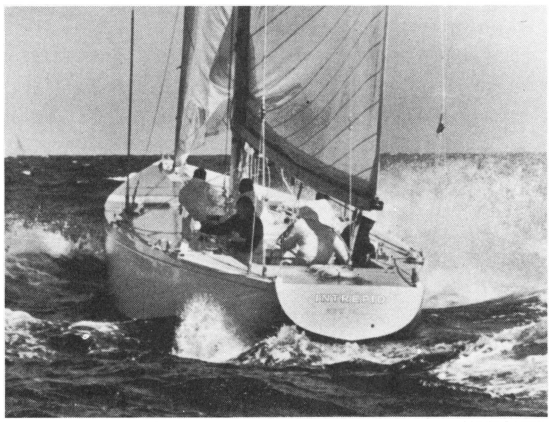
Sailing Across the Wind, with the wind *abeam*, is called *reaching*. Sailboats can usually move faster when sailing across the wind than in any other direction. Some light sailboats with flat bottoms can move fast enough in a good breeze to lift out of the water and *plane* on the surface like a motorboat. This gives a great sensation of speed even though the boats seldom travel more than 20 miles (32 kilometers) per hour.

Sailing Before the Wind is called *running*. Contrary to what might be expected, running is not so fast as reaching or sailing to windward. In running, the sail is simply pushed along by the wind and makes its own resistance at the same time. When sailing downwind, many racing boats use spinnakers for added speed. These huge sails lift the boat along.

Trimming and Tacking are two basic skills all sailors must learn in order to handle their boats effectively.

Trimming means adjusting the sails to obtain the full





Wide World

A Yacht tacks when sailing into the wind. The crew maneuvers the boat by changing the position of the rudder and the sails.

advantage of the available wind. A sailor must always know the wind direction in order to trim his sails correctly. When the boat is running before the wind, the mainsail is at right angles to the boat's direction. If a spinnaker is used, it is rigged out on one side of the mast on its own boom, called a *spinnaker pole*. The mainsail is on the other side of the mast. When the boat is sailing across wind, the mainsail extends about halfway out from the boat, or at about a 45-degree angle to its direction of travel. When the boat is sailing into the wind, the sails should be trimmed as parallel as possible to the boat's direction.

Small sailboats can easily *capsize* (overturn) if mishandled. Experienced sailors know where to place their weight and how to relieve dangerous pressure on the sails if a boat tips too far. This is done by *slacking off* (letting the sails out) so some of the wind spills from them. If a boat does capsize, the crew should hang on to it until rescued. All sailors, especially those who are weak swimmers, should always wear life jackets. See SWIMMING (Water Safety).

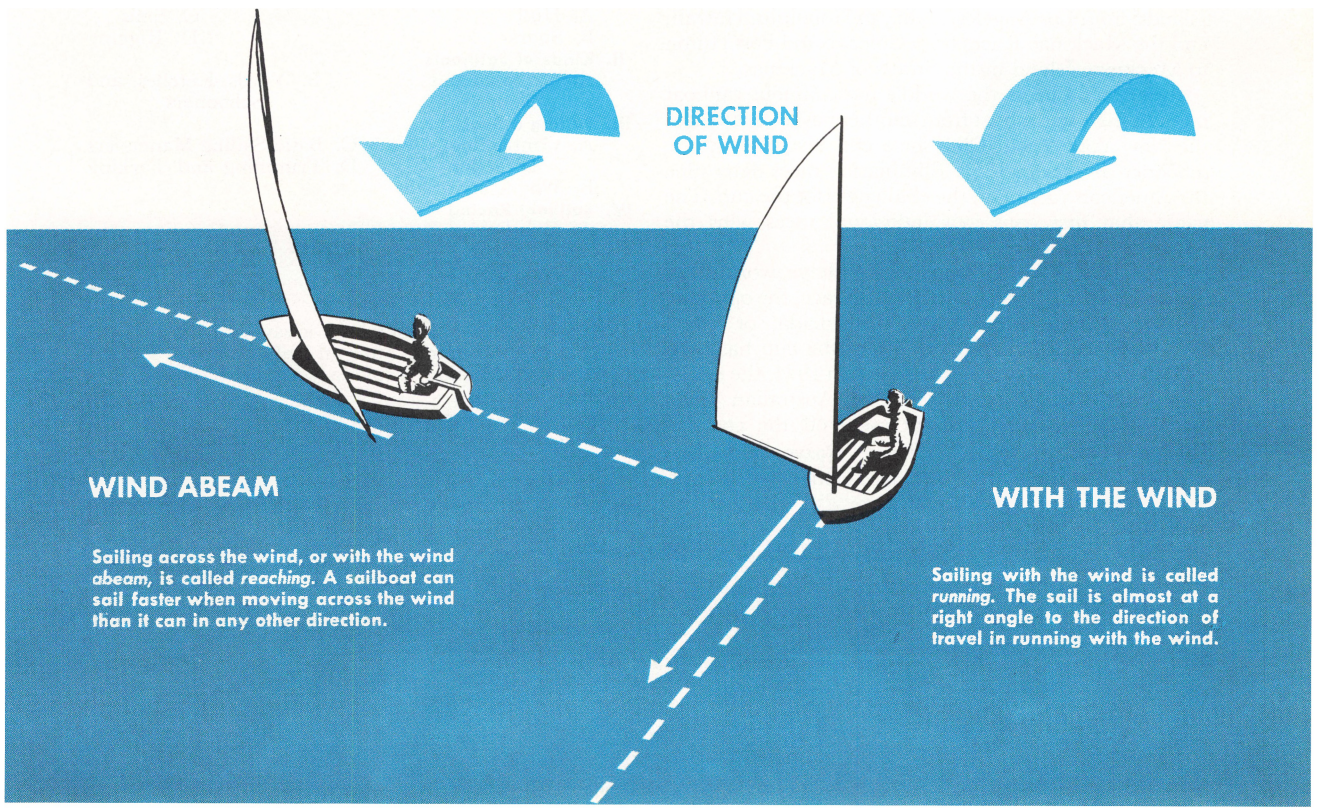
Tacking involves turning the boat so that the wind comes at it from the opposite side. When sailing into the wind, this is called *coming about*. In coming about, the bow is turned so that the wind crosses it. This is a comparatively safe maneuver. When the stern is to the wind, a turn that brings the wind to the other side of the boat is called *jibing*. Then, the wind crosses the stern quickly, and the sail slams across the boat. This quick shift of forces can capsize a boat if the maneuver is not handled carefully and with skill.

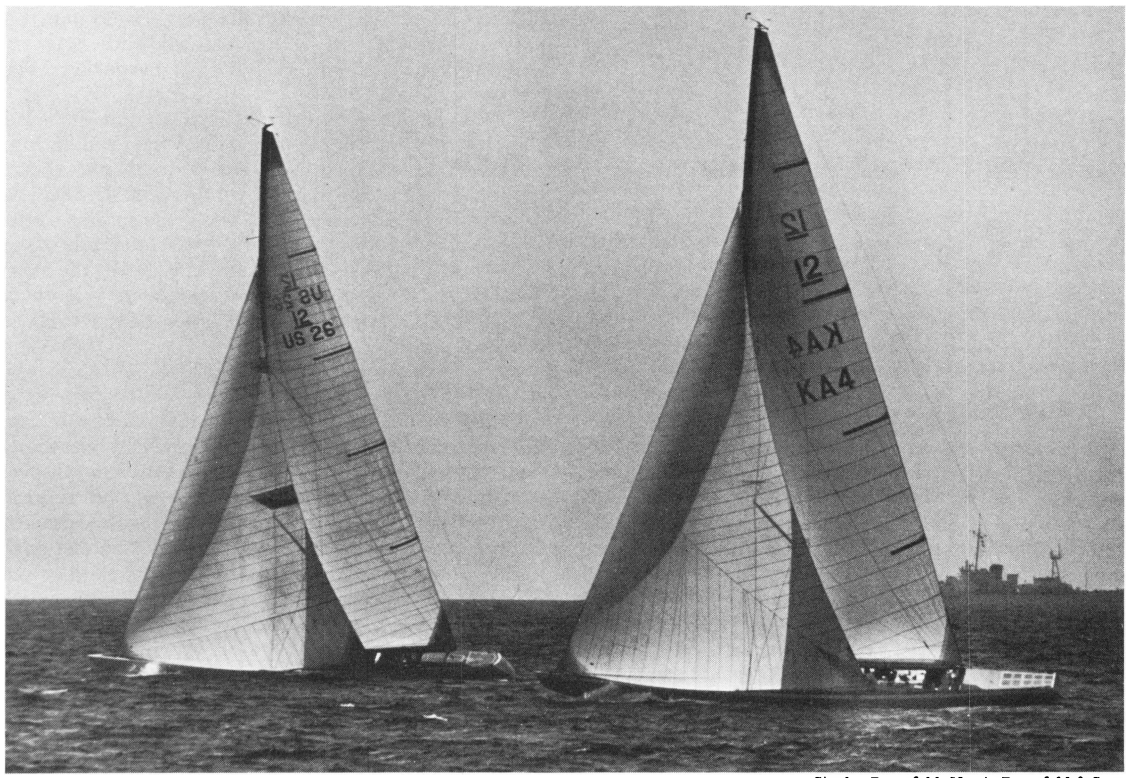
Sailboat Racing

One-Design Races. The largest number of races are held for the catboats and sloops that make up the many one-design classes of boats. The boats usually sail over triangular courses in protected waters near a local yacht or boating club. These are evenly matched races, because all the boats in a particular class are designed and built alike. This makes the skill of the skipper and his crew the most important factor in winning a sailboat race.

But the care with which a crew maintains its boat and prepares it for a race is also important. The way the crew members *tune* (adjust the rigging) and mount the sails has much to do with a boat's speed. A bad paint job on a sailboat's hull will slow it down, because the hull will not slip through the water easily.

Handicap Races involve boats of different sizes and designs. All the boats cross the starting line together, but the smaller boats have a *handicap* (time allowance). A smaller boat can win even though it finishes far behind a larger boat. Most long ocean races for larger





Stanley Rosenfeld, Morris Rosenfeld & Sons

The America's Cup is the oldest international sailing race. Sailboats representing the United States have defeated all challengers since the U.S. yacht *America* won the first race in 1851.

sailboats are handicap races. Some of the best-known races are from Miami, Fla., to Nassau in the Bahama Islands; from Los Angeles, Calif., to Honolulu, Hawaii; and the Mackinac Races from Chicago and Port Huron to Mackinac Island in the Straits of Mackinac.

America's Cup is the world's most famous sailboat race. In this race, a boat from another nation challenges the New York Yacht Club for a cup first won by the schooner *America* in 1851. Elimination races determine the American yacht and the challenger for the cup. The yacht that first wins four individual races wins the America's Cup.

Since 1851, United States yachts have won all 22 America's Cup competitions. In each race, the opposing yacht has represented Australia, Canada, or Great Britain. Since 1958, competition for the cup has been held at intervals of two to four years. In 1974, the American yacht *Courageous* defeated the Australian yacht *Southern Cross* in four straight races off the coast of Newport, R.I.

WILLIAM W. ROBINSON

Related Articles in WORLD BOOK include:

Boating
Brig
Caravel
Catamaran
Chichester, Sir Francis
Clipper Ship
Frigate
Galleon
Galley
Junk
Lipton, Sir Thomas Johnstone
Ship
United States Coast Guard Academy (picture: Aboard the *Eagle*)
Yawl

Outline

I. The Parts of a Sailboat
- A. Hull
- B. Spars
- C. Sails
- D. Rigging

II. Kinds of Sailboats
- A. Catboats and Sloops
- B. Yawls, Ketches, and Schooners

III. Sailing a Boat
- A. Controlling Direction
- B. Why a Boat Sails
- C. Basic Sailing Maneuvers
- D. Trimming and Tacking

IV. Sailboat Racing
- A. One-Design Races
- B. Handicap Races
- C. America's Cup

Questions

How does a sloop differ from a yawl?
What sail was named after an Italian port?
In what direction would a boat be sailing if it is *reaching? Running?*
When would a *spinnaker* be used?
What is the world's most famous sailboat race?
Why is Dacron an excellent material for sails?
On what basis are the various sailboats classified?
How does a *sailing auxiliary* differ from the standard large sailboat?
Why is a *jibing* turn difficult for a sailboat?
How does a centerboard enable a sailboat to enter shallow water?

SAILOR'S-CHOICE. See GRUNT.

SAILPLANE. See GLIDER.

SAINT is a holy person who becomes a religious hero by exemplifying a virtue or virtues of his or her religion. The word comes from the Latin word *sanctus*, meaning *a holy one*.

The followers of a religion regard its saints as unusually blessed. They believe these saints are able to give special blessings and to exercise certain superhuman powers. All the world's major religions *revere* (deeply respect) saints, but in different ways. Some religions have formal procedures for officially granting sainthood to certain men and women. Other religions do not formally recognize saints, but they have religious practices that honor holy persons.

Many persons achieve sainthood because they played a major role in the history of their religion or symbolize a traditional feature of it. For example, Saint Paul converted to Christianity from another religion and became a great missionary who sought other converts. Some saints are martyrs who died for a holy cause. Many Christians who died rather than give up their faith during early Christianity are now considered saints.

A number of saints are considered especially close to God. Roman Catholics believe that the Virgin Mary is so loved by God that she rose bodily to heaven.

Some saints, such as Buddha, are believed to have gained superhuman or special knowledge about, or insight into, holy mysteries. Eastern Orthodox Christians revere Saint John Chrysostom for his wisdom.

Some persons are revered as saints because before or after death they performed miracles and pleaded with God for blessings or curses on particular persons. Others achieved sainthood because their *relics* (remains or possessions) or some place associated with them came to be regarded as holy.

Still others are considered saints because before or after death they became *demigods* (partly a god and partly human) and had divine powers. Before World War II, believers in one form of Shintoism regarded the emperor of Japan as divine.

Non-Christian Saints

Judaism forbids praying to any being other than God. But Jews honor saintly persons as heroes. In Jewish worship, the heroic deeds of holy persons may be recited as examples of faithfulness to God. Such early heroes as Jacob and David sometimes broke Jewish laws. But later Jewish saints were learned in the *Torah* (religious law) and firm in following its rules of behavior. Jewish saints have been called "toilers in the Torah." The most famous Jewish saints include Hillel the Elder and Akiba ben Joseph.

Islam credits supernatural powers only to *Allah* (God). All Moslems acknowledge as saints such heroes as Mohammed and Ali. The Islamic holy book, the Koran, does not provide for the worship of saints, but each locality cherishes a saint called *wali* (benefactor, companion, or friend). Moslem saints are considered to be close to God but not divine. The spiritual powers they exercised as living persons increase when they die. Then, their influence centers on their tombs and relics, especially their robes. Moslems believe each saint can perform a special miracle. A visit to a saint's tomb, with its holy objects and often its pool or fountain, is believed to provide advice, to cure a disease, or to grant children to a childless woman.

The Oriental religions have a greater variety of practices and beliefs regarding saints than do the Western religions. Buddhism honors the buddhas and their close disciples, along with relics and sacred places associated with them. Buddhist monks and nuns recognize patron saints as special guardians, and Buddhist martyrs are honored as religious heroes. Hinduism has no official saints for all Hindus. There are many ranks of semidivine local or regional saints. A Hindu village, tribe, or religious order may raise its own heroes or protectors to sainthood. Confucianism has holy men who are *sages* (wise men) of intellectual and moral superiority. The most famous sage is Confucius. Shintoism has no human saints or martyrs because its holy persons are considered divine.

Christian Saints

The more traditional Christian denominations emphasize the honoring of saints. The Eastern Orthodox Churches, the Roman Catholic Church, some Lutheran churches, and the churches of the Anglican Communion regard many of the same persons as saints.

A *canonized* saint is a person whose name is included in a *canon* (official list). Christian saints were first considered saints by common agreement among people in a certain area, and later by regional bishops. Gradually, the authority to canonize saints for Latin Christians centered on the pope.

The earliest Christian writings call all believers *saints*. This practice has been renewed by several modern denominations, including the Mormons (Latter-day Saints). During the 200's, the term *saint* referred specifically to martyrs, and in the 300's to bishops. By the 500's, the term referred to all departed heroes of Christianity who were honored in worship services. In the early forms of honoring a martyr, believers living in his locality gathered at his tomb on the anniversary of his death. The fame of certain saints gradually spread to other congregations, and by the 500's some famous saints were revered throughout the Christian world.

After many martyrs, bishops, monks, scholars, miracle-workers, and other heroes had entered the list of saints, their relics were considered able to give special blessings. Believers asked the saints to plead with God for special favors. The Christian saints were popularly regarded as holy before they became officially recognized as saints. During the Middle Ages, popular religious sentiment sometimes disregarded the difference between worshiping or adoring God and *venerating* (showing religious devotion to) saints. By the early 1500's, many people prayed to the saints and their relics for special assurances of salvation. Certain practices developed around the veneration of some Christian saints, but were later considered superstitious. For example, many people thought St. Lazarus could cure measles if a person who had the disease prayed to him.

During the Reformation, both Protestants and Catholics attacked abuses in the worship of saints. Most Protestants refused to revere any persons as saints except certain heroes mentioned in the New Testament. After the Reformation, the Roman Catholic Church re-

stated the manner in which followers could call on saints for help or protection. Catholic saints were clearly ranked lower than God, and superstitious or other *impious* (disrespectful) practices regarding them were outlawed. Roman Catholics, members of Eastern Orthodox Churches, and some Protestants still ask saints to plead with God in their behalf.

Roman Catholic Saints

Present Roman Catholic procedures of canonization were officially established in the 1600's. A commission appointed by the church strictly examines the subject's life and works and any miracles associated with the person. If the investigation produces enough evidence, the person is eligible for *beatification*. That is, he or she may officially be declared "blessed." If further investigation produces proof of two miracles associated with the person, he may be canonized as a saint.

Canonization consists of declaring that a person believed to be holy was indeed a saint during his lifetime and is in heaven with God. This official status does not approve all that the individual said, did, or wrote. Among Roman Catholics, only the pope can grant official recognition to a person nominated for beatification or canonization.

In 1969, the Vatican announced a revision of the church's liturgical calendar, which lists the feast days of saints celebrated by the church. The new calendar listed 58 saints. But many more saints could continue to be venerated locally. The church also made optional the celebration of the feast days of other saints.

Children of Catholic parents and many others are named after a saint, often the saint on whose day the child was born or baptized. That saint becomes the child's special guardian or patron. A number of cities, especially in the Western Hemisphere, are named after saints. They include Saint Louis, Mo., and São Paulo (Saint Paul), Brazil. In many denominations, parish churches or congregations take the names of saints. Many Christians, recognizing that many holy men and women have never been canonized, celebrate them on All Saints' Day, November 1. WILLIAM A. CLEBSCH

Related Articles. See CANONIZATION; ALL SAINTS' DAY; and the table of popes with the POPE article. Other related articles in WORLD BOOK include:

Agnes, Saint
Albertus Magnus, Saint
Alphonsus Liguori, Saint
Ambrose, Saint
Andrew, Saint
Anne, Saint
Anselm, Saint
Anthony of Padua, Saint
Anthony of Thebes, Saint
Aquinas, Saint Thomas
Athanasius, Saint
Augustine, Saint
Augustine of Canterbury, Saint
Bartholomew, Saint
Basil, Saint
Becket, Saint Thomas à
Bellarmine, Saint Robert
Bernadette, Saint
Bonaventure, Saint
Boniface, Saint
Borromeo, Saint Charles
Bosco, Saint John
Brébeuf, Saint Jean de
Bridget, Saint
Cabrini, Saint Frances Xavier
Canisius, Saint Peter
Catherine of Siena, Saint
Cecilia, Saint
Christopher, Saint
Chrysostom, Saint John
Cyril of Alexandria, Saint
Cyril of Jerusalem, Saint
David, Saint
Denis, Saint
Dismas, Saint
Dominic, Saint
Dunstan, Saint
Edward the Confessor
Elizabeth, Saint
Fisher, Saint John
Francis de Sales, Saint
Francis of Assisi, Saint
George, Saint
Gonzaga, Saint Aloysius
Ignatius, Saint
Irenaeus, Saint
James (saints)
James, Saint
Jean Baptiste de la Salle, Saint
Jerome, Saint
Joan of Arc, Saint
Jogues, Saint Isaac
John the Baptist
John the Evangelist, Saint
Joseph
Jude, Saint
Justin the Martyr, Saint
Louis (IX)
Loyola, Saint Ignatius
Luke, Saint
Mark, Saint
Matthew, Saint
Matthias, Saint
Michael, Saint
More, Saint Thomas
Neri, Saint Philip
Nicholas, Saint
Patrick, Saint
Paul, Saint
Paul of the Cross, Saint
Peter, Saint
Philip of Bethsaida, Saint
Polycarp, Saint
Rose of Lima, Saint
Sebastian, Saint
Simon the Canaanite, Saint
Stanislas, Saint
Stephen, Saint
Swithin, Saint
Theresa, Saint
Thérèse of Lisieux, Saint
Thomas, Saint
Ursula, Saint
Valentine, Saint
Veronica, Saint
Virgin Mary
Vladimir I
Xavier, Saint Francis

SAINT, THOMAS. See SEWING MACHINE (History).

SAINT ALBANS, Vt. (pop. 8,082), is called the *Maple Syrup Capital of the U.S.* It lies in Franklin County, which is a leading producer of maple syrup. St. Albans serves as the headquarters of the Central Vermont Railway, a branch of the Canadian National Railways. The city lies in the northwestern corner of Vermont, 19 miles (30 kilometers) south of the Canadian border. For location, see VERMONT (political map). Dairy products, flashlight cases, paper food containers, and sugar-making equipment are made there.

On Oct. 19, 1864, Confederate soldiers who fled to Canada attacked the North in the *Saint Albans Raid.* The Fenians, Irish patriots, used the city as a base in trying to attack Canada in 1866. St. Albans has a council-manager government. WALTER R. HARD, JR.

SAINT ALBERT'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT ALPHONSUS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT AMBROSE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT ANDREWS (pop. 12,522) lies on the east coast of Scotland between Edinburgh and Dundee. This farm town is sometimes called the *Capital of Golf.* The Royal and Ancient Golf Club, founded here in 1754, establishes many of the rules for the game. Scotland's oldest university, the University of St. Andrews, was founded in 1411. See also SCOTLAND (picture: The Royal and Ancient Golf Club). J. WREFORD WATSON

SAINT ANDREWS, New Brunswick (pop. 1,812), is often called *Saint Andrews-by-the-Sea.* St. Andrews lies on Passamaquoddy Bay, about 60 miles (97 kilometers) west of St. John, and about 5 miles (8 kilometers) east of the United States border (see NEW BRUNSWICK [political map]). The many small islands in the bay and the ocean shoreline make the town a popular tourist center. St. Andrews was founded in 1784 by United Empire Loyalists (see UNITED EMPIRE LOYALIST). W. S. MACNUTT

SAINT ANDREW'S CROSS. See CROSS (picture).

SAINT ANDREW'S DAY commemorates the martyrdom of Saint Andrew in about A.D. 70. It is also known as *Andry's Day* or *Andermass.* Many branches of the

Christian Church celebrate November 30 as his feast day. Saint Andrew was the brother of Saint Peter, and one of the 12 Apostles of Jesus Christ. He became the patron saint of Scotland. Scottish people have organized Saint Andrew's societies that are dedicated to helping the poor. RAYMOND HOYT JAHN

See also ANDREW, SAINT.

SAINT ANDREWS PRESBYTERIAN COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT ANSELM'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT ANTHONY, FALLS OF. See FALLS OF SAINT ANTHONY.

SAINT ANTHONY'S CHAPEL. See IOWA (Places to Visit).

SAINT ANTHONY'S CROSS. See CROSS (picture).

SAINT ANTHONY'S FIRE. See ERGOT; ERYSIPELAS.

SAINT AUGUSTINE, Fla. (pop. 12,352), is the oldest city in the United States. It was founded in 1565 by the Spaniard Pedro Menéndez de Avilés. The Spanish explorer Juan Ponce de León had visited the present-day St. Augustine area as early as 1513. The city lies on the Atlantic Coast in northeastern Florida (see FLORIDA [political map]). St. Augustine's historic sites and fine beaches attract many tourists. The city has a council-manager form of government. See also FOUNTAIN OF YOUTH; CASTILLO DE SAN MARCOS NATIONAL MONUMENT. KATHRYN ABBEY HANNA

SAINT AUGUSTINE'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT BARTHOLOMEW'S DAY, MASSACRE OF, was a slaughter of French *Huguenots* (Protestants). The massacre began on Aug. 24, 1572, in Paris. The massacre spread throughout France, and thousands of Huguenots were killed before the violence ended.

During the mid-1500's, the French Roman Catholics and Huguenots fought bitterly. The Huguenots had become so numerous that the Roman Catholics feared they would take control of the French government. A civil war began in 1562 and lasted eight years. In 1570, the Peace of Saint-Germain granted the Huguenots liberty. But fear of the growing Huguenot political power led Catherine de Médicis, the mother of King Charles IX, and other Roman Catholic leaders to plot the assassination of leading Huguenots. The attempted murder of Gaspard de Coligny, one of the most respected Huguenot leaders, caused great tension in Paris.

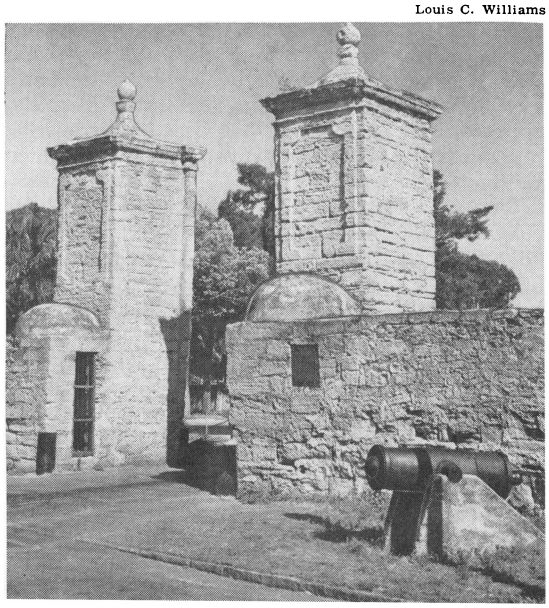
Catherine convinced King Charles that the Huguenots would attack the palace and might kill him. Charles then ordered the death of leading Huguenots. He reportedly said, "Kill them all so that not a single one be left to reproach me." Henry de Guise, Coligny's enemy, led a group who murdered Coligny on St. Bartholomew's Day. Other well-known Huguenots were killed in Paris. Mobs then killed thousands of Huguenots throughout France. EDWIN J. WESTERMANN

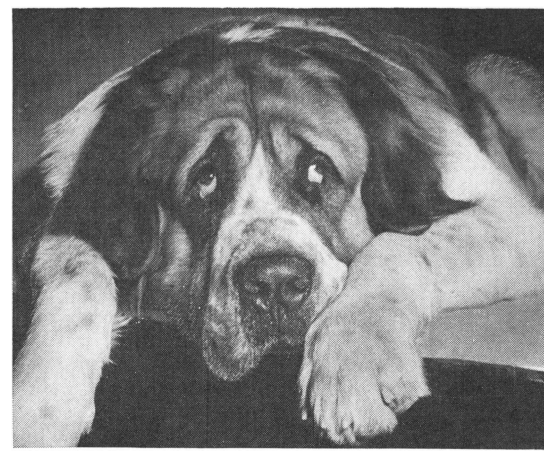
See also HUGUENOTS; CATHERINE DE MÉDICIS; CHARLES (IX) of France.

SAINT BENEDICT, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

The Gates of St. Augustine, Fla., formed part of the city's defenses. These stone gates were built in 1804.

Louis C. Williams





Yila

The Saint Bernard Has a Huge, Sad-Looking Face.

SAINT BERNARD is a large intelligent dog that has become famous for rescuing lost travelers. The dog gets its name from the fact that it was developed by a group of monks in the monastery of St. Bernard, in the Alps of Switzerland. There were formerly foot travelers in the Alps. They often lost their way, or became buried in sudden snowdrifts or snowstorms. The St. Bernard was trained to rescue such persons. With its keen sense of smell, the St. Bernard could find persons who were buried under the snow. After it had found the lost traveler, it called out for help by barking loudly. They were also trained to guide travelers over treacherous trails, giving warning of dangerous footing. An English artist, Sir Edwin Landseer, painted a popular picture of the dog with a small cask hanging from a collar around its neck. But authorities say the St. Bernard never carried casks on rescue missions.

The St. Bernard is valued as a watchdog. It is also a good guide dog and pet. It is strong and tall, measuring about $2\frac{1}{2}$ feet (76 centimeters) high from the shoulder to the ground. It weighs from 140 to 220 pounds (64 to 100 kilograms), and is one of the heaviest dogs. The dog has a red and white body with some black on its head. Its hair may be either long or short, though in America

Hospice of Saint Bernard stands in Great Saint Bernard Pass in the Alps, on the Swiss border with Italy. The hospice has been a refuge for travelers for nearly 1,000 years.

Swiss National Tourist Office

the most common type has long hair. The St. Bernard has a large, square head, a short muzzle, and a short neck. OLGA DAKAN

See also DOG (color picture: Working Dogs).

SAINT BERNARD COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT BERNARD PASSES are two high passes across the Swiss Alps. They are called Great Saint Bernard and Little Saint Bernard (see SWITZERLAND [color map]). The Romans used them as military roads. Today, motor roads cross the passes. Each pass has a *hospice* (refuge for travelers). The $3\frac{1}{2}$-mile (5.6-kilometer) Great St. Bernard Tunnel for automobiles, linking Italy and Switzerland, was opened to traffic in 1964.

Great Saint Bernard. The road leading across Great St. Bernard begins at Martigny, in the Rhône Valley. It follows the Val d'Entremont to an elevation of 8,110 feet (2,472 meters). The road then descends into northwestern Italy by way of Val d'Aosta. The gray stone St. Bernard Hospice stands at the highest point in the pass. It was founded in the 1000's by Saint Bernard of Menthon. Augustinian monks offer refuge for travelers at the hospice. During the severe winter months, the monks and their famous St. Bernard dogs save the lives of many wayfarers. In normal winters, the road to the pass is only partially open, isolating the hospice from the outside world. Food supplies and mail must then be carried to the top of the pass by lay brothers and monks. The life of the monks is so severe that only young men are chosen to serve. Most of the monks are excellent mountain guides, climbers, and skiers. Many summer travelers visit the hospice, which has room for over 300 persons. But no one may stay there longer than one day except in an emergency.

Little Saint Bernard lies about 25 miles southwest of Great St. Bernard. Its hospice dates from 962, and is nestled in the pass at an elevation of 7,170 feet (2,185 meters). Little St. Bernard is 10 miles (16 kilometers) south of Mont Blanc, one of the highest peaks in Europe. FRANKLIN CARL ERICKSON

See also ALPS; SAINT BERNARD.

SAINT BONAVENTURE UNIVERSITY. See UNIVERSITIES AND COLLEGES (table).

SAINT CATHARINES, Ontario (pop. 109,722; met. area 303,429), is the center of a rich fruit-growing area on the Niagara peninsula. It stands beside the Welland Canal. For location, see ONTARIO (political map).

In addition to packing and canning fruits and vegetables, industries there manufacture farm tools, automotive parts, paper and wood products, and textiles. Ridley College, a boys' school, is located there. The Henley Rowing Regatta and the St. Catharines Horse Show are held there each year. St. Catharines was settled about 1796. D. M. L. FARR

SAINT CATHERINE, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

SAINT CHARLES BORROMEO SEMINARY. See UNIVERSITIES AND COLLEGES (table).

SAINT CHRISTOPHER-NEVIS-ANGUILLA. See WEST INDIES ASSOCIATED STATES.

SAINT CLAIR, ARTHUR (1736-1818), was a Scottish-American soldier and statesman. He served as a British army officer in America during the French and Indian War. When the Revolutionary War broke out, he joined the colonial army, and organized the New Jersey troops. St. Clair fought at Trenton and Princeton, and became a major general. He commanded Fort Ticonderoga, but did not try to defend it against General John Burgoyne. His failure to defend the fort caused much criticism and he was recalled from service.

After the war, St. Clair won a seat in the Congress of the Confederation as a representative for Pennsylvania. In 1787, he became president of the congress. That same year, St. Clair became governor of the Northwest Territory. After a defeat in battle by the Miami Indians in 1791, he resigned his army command. In 1802, St. Clair objected to the law which made Ohio a state and had to resign as governor. He was born in Thurso, County Caithness, Scotland. JOHN R. ALDEN

SAINT CLAIR, LAKE. See LAKE SAINT CLAIR.

SAINT CLOUD, Minn. (pop. 39,691; met. area 134,585), is a center of the granite industry. The city ranks high in the production and processing of colored granite. Leading products include optical lenses and railway freight cars. The city serves as a central Minnesota wholesale and retail shipping center. It lies on the Mississippi River, about 70 miles (110 kilometers) northwest of Minneapolis (see MINNESOTA [political map]).

Ole Bergeson, a Norwegian, staked the original claim to the site of Saint Cloud in the early 1850's. In 1853,

John L. Wilson, a pioneer from Maine, paid Bergeson $250 for the 325 acres (132 hectares) where the business district now stands. Wilson named the settlement Saint Cloud after a suburb of Paris, France. In the 1850's and 1860's, it was a terminal on a stage line that extended from the Mississippi River to the Red River Colony (now Winnipeg, Canada). Saint Cloud received its city charter in 1868. It is the seat of Stearns County, and has a mayor-council government. HAROLD T. HAGG

SAINT CLOUD STATE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT CROIX. See VIRGIN ISLANDS.

SAINT CROIX ISLAND NATIONAL MONUMENT, on the Canadian border in eastern Maine, is the site of one of the first French settlements in North America. Explorers Sieur de Monts and Samuel de Champlain established a colony there in 1604. It was abandoned in 1605. The 35.39-acre (14.32-hectare) site is on St. Croix Island in the St. Croix River, and on the southern bank of the river. Congress authorized the monument in 1949, but all the land was not acquired until 1967.

SAINT CROIX RIVER. See MAINE (Rivers and Lakes).

SAINT DAVID'S DAY is celebrated on March 1 in honor of the patron saint of Wales. He was born in the British Isles, probably in the A.D. 400's, and became bishop of a Roman port, now St. David's. Legend says he was a relative of King Arthur, a pilgrim to Jerusalem, and a leader against the Saxons. The day has been celebrated in America since 1729. RAYMOND HOYT JAHN

SAINT DENIS, RUTH (1877?-1968), was an American dancer, dance teacher, and *choreographer* (dance composer). For more than 70 years, she devoted herself to proving that dance could express "the noblest thoughts of man."

Photo by Lou Goodale Bigelow
(The Dance Collection, New York Public Library)

Ruth Saint Denis was fascinated by Eastern and Oriental dances. She danced *Siamese Ballet* with her partner, Ted Shawn.

Ruth St. Denis was born in Newark, N.J. She considered the dances she saw as a girl to be superficial, and turned to the East for ideas about dance as a spiritual art. She choreographed and performed in *Radha* (1906), a dance about a Hindu goddess. She also composed and danced in the Japanese ballet *O-Mika* (1913) and in other adaptations of Oriental material. In 1915, she and her husband, Ted Shawn, opened the Denishawn school in Los Angeles and formed the Denishawn dance company. Their students included Martha Graham, Doris Humphrey, and Charles Weidman. The company toured the U.S. from 1915 to 1931. Miss St. Denis devoted much of her later life to composing religious dances that were staged in churches. SELMA JEANNE COHEN

See also SHAWN, TED.

SAINT EDWARD'S UNIVERSITY. See UNIVERSITIES AND COLLEGES (table).

SAINT ELIAS MOUNTAINS are a rugged series of the world's highest coastal mountains. They stand along the southeastern boundary of Alaska and the Yukon Territory. The range is nearly 300 miles (480 kilometers) long. It has a maximum width of 100 miles (160 kilometers), excluding the coastal plain and foothill belt. The international boundary is 30 miles (48 kilometers) from the coast between Mount Saint Elias and Mount Fairweather (see ALASKA [physical map]).

The second and fourth highest peaks in North America stand in the Saint Elias Mountains. They are Mount Logan (19,850 feet, or 6,050 meters) in the Yukon Territory, and Mount Saint Elias (18,008 feet, or 5,489 meters) in Alaska. Twelve other peaks in the range, including mounts Vancouver, Fairweather, and Hubbard, are higher than any other U.S. peaks outside Alaska.

The ruggedness of the range prevents extensive exploration. Many peaks are unnamed. The mountains are composed chiefly of sedimentary and volcanic rocks of the Paleozoic and Mesozoic ages (see EARTH [table: Outline of Earth History]). The range has frequent rains. Glaciers can be found throughout the mountain area. The largest glacier, called Malaspina, is larger than the state of Rhode Island. LYMAN E. ALLEN

See also ALASKA (Land Regions); MOUNT LUCANIA.

SAINT ELIZABETH, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

SAINT ELMO'S FIRE is the name given to a round flash of light that is seen around ships in a thunderstorm. This flash of light gets its name from the fact that it looks like fire. It is actually a charge of electricity caused by the storm. In stormy weather, it can be seen around airplanes, the masts of ships, at steeple tops, and at tree tops. It also may be seen around horses' manes and people's heads. The name *Saint Elmo* is a shorter form of the name of *Saint Erasmus*, who was considered the patron saint of Mediterranean sailors.

See also JACK-O'-LANTERN.

SAINT-ÉTIENNE, *SAN TAY TYEHN* (pop. 213,468; met. area 331,414), is a leading industrial city 31 miles (50 kilometers) southwest of Lyon, in south-central France. It stands on the slopes of the Furens River valley. With Lyon and Roanne, Saint-Étienne forms the major industrial triangle of central France. Its indus-

tries include blast furnaces, iron foundries, steel mills, armament plants, and ribbon factories. Its ribbon industry dates from the 1400's. For location, see FRANCE (political map).

SAINT-EXUPÉRY, *san tehg zoo pay REE,* **ANTOINE DE** (1900-1944), was the chief influence in the creation of the literature of aviation. He was a flier himself, and died an aviator's death, disappearing while on an Allied reconnaissance mission during World War II. Saint-Exupéry was an air pioneer, opening routes over Africa, the South Atlantic, and the Andes Mountains.

During the campaign of France from May to June, 1940, he led a squadron in an unequal fight against superior German air forces. He wrote *Night Flight* (1932), *Wind, Sand and Stars* (1939), and *The Little Prince* (1943). He was born in Lyon, France. HENRI PEYRE

SAINT FRANCIS, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

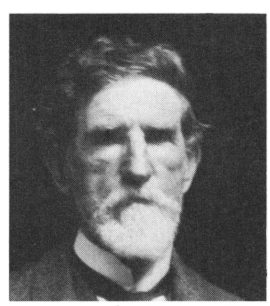
SAINT FRANCIS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT FRANCIS RIVER. See QUEBEC (Rivers).

SAINT FRANCIS XAVIER UNIVERSITY is a coeducational Roman Catholic university in Antigonish, N.S. It was founded in 1853. The main campus has faculties of arts and science. It also includes the Coady International Institute, an extension department, and the two-year Xavier College in Sydney, N.S. Mount St. Bernard College and St. Martha's School of Nursing are affiliated with it. For enrollment, see CANADA (table: Universities and Colleges). MALCOLM MACLELLAN

SAINT-GAUDENS, *GAW duhnz,* **AUGUSTUS** (1848-1907), was an American sculptor whose work is noted for its lifelike qualities. He became famous overnight in 1880 with his statue of Admiral David Farragut, which now stands in Madison Square in New York City. His works include *The Puritan* or *Deacon Chapin* in Springfield, Mass., *The Standing Lincoln* in Chicago, and *Captain Randall* on Staten Island. Saint-Gaudens' first statue was *Hiawatha,* completed in 1871. He designed the statue of *Diana* on the tower of the old Madison Square Garden that stood at Madison Avenue and East 26th Street in New York City. Saint-Gaudens is also noted for his *Shaw Memorial* in Boston, and *Adoration of the Cross,* a bas-relief statue in St. Thomas Church in New York City.

Saint-Gaudens was born in Dublin, Ireland. He attended school in New York, but left at 13 to work for a cameo cutter. He studied drawing at Cooper Union, the National Academy of Design, and the École des Beaux-Arts. His earliest work was a bronze bust of his father. JEAN LIPMAN



The Bettmann Archive

Augustus Saint-Gaudens

See also UNITED STATES (The Arts in the United States [picture: Deacon Samuel Chapin]).

SAINT GEORGE, Utah (pop. 7,097), is the site of a $1-million Mormon Temple, the first completed in Utah. The city is in the southwest corner of the state. For location, see UTAH (political map). In 1892, St. George experienced the hottest temperature recorded in Utah, 116° F. (47° C). Early settlers called the area "Utah's Dixie," because the climate encouraged them to grow and mill cotton. The region is famous for fruit, and is a tourist center. A. R. MORTENSEN

Brown Bros.

***The Standing Lincoln* by Augustus Saint-Gaudens** is in Lincoln Park in Chicago. Saint-Gaudens carved many other public monuments in the United States.

SAINT GEORGE ISLAND. See PRIBILOF ISLANDS.

SAINT GEORGE'S (pop. 9,000) is the capital, chief port, and commercial center of Grenada, an island nation in the West Indies. The city lies on the southwest coast of Grenada, one of the Windward Islands. For location, see GRENADA (map).

In 1650, the French founded a settlement near what is now Saint George's. The town was moved to its present site in 1705. Great Britain gained control of Grenada in 1783, and Saint George's later became the center of government of all the Windward Islands. Grenada gained independence from Britain on Feb. 7, 1974, and Saint George's became the capital. The city's main industry is tourism. GUSTAVO A. ANTONINI

SAINT GEORGE'S CHANNEL is an arm of the Atlantic Ocean that separates Wales from southern Ireland. It is about 100 miles (160 kilometers) long, and from 60 to 100 miles (97 to 160 kilometers) wide. The channel runs from Holyhead and Dublin to Saint David's Head, joining the Irish Sea with the Atlantic Ocean (see GREAT BRITAIN [color map]).

SAINT GEORGE'S CROSS. See CROSS (Other Crosses; picture).

SAINT GERMAIN, *saynt jur MAYN,* or *SAN ZHEHR MAN,* **TREATY OF.** The Allied powers of World War I and the republic of Austria signed the Treaty of Saint Germain on Sept. 10, 1919. Twenty-seven Allied and associated countries signed the agreement which broke Austria's power. Romania and Yugoslavia were the only two Allied countries that delayed signing. These countries objected to treaty guarantees given to minority groups. Several months passed before they were persuaded to sign the document. The Austrian National Assembly ratified the Treaty of Saint Germain on

Oct. 17, 1919, and the agreement went into force on July 16, 1920.

The Treaty of Saint Germain was much like the Treaty of Versailles. Part I of the treaty provided that Austria could be admitted to the League of Nations after a period of good behavior. Part II reduced Austria's territory from about 115,000 square miles (297,800 square kilometers) to only 32,369 square miles (83,835 square kilometers). The population was thereby reduced from 30 million to 6 million. Eight clauses guaranteed the independence and safety of Austria's minority groups.

The Treaty of Saint Germain gave complete independence to Poland, Yugoslavia, Czechoslovakia, and Hungary. These nations, together with Italy, also gained much territory that Austria had controlled before the war. Military clauses reduced the Austrian army to 30,000 soldiers. Only one factory could manufacture military armaments. Much of the Austro-Hungarian navy passed into the hands of the Allies, and Austria was left with only four patrol boats. Even these were only for inland-water protection, for Austria had lost all its seaports.

One of the important clauses of the Treaty of Saint Germain forbade union between the countries of Austria and Germany. But in 1938, Hitler forced a union with Austria. World War II set aside the Treaty of Saint Germain. DWIGHT E. LEE

SAINT GOTTHARD PASS, *GAHT urd,* is a famous mountain pass in the Lepontine Alps of southern Switzerland. It is a level depression, surrounded by a number of small lakes. The Rhine and Rhône rivers begin near the pass. A road with many hairpin turns crosses the pass at 6,935 feet (2,114 meters) above sea level. The rich farming and industrial valley of the Po River in northern Italy lies south of the pass.

Travelers first used the pass in the 1200's. The League of Three Cantons, the first three "states" of early Switzerland, guarded approaches to the pass during these early years. A hospice was founded in Saint Gotthard Pass in the 1300's to give aid to travelers. JACK R. VILLMOW

SAINT GOTTHARD TUNNEL is a railroad tunnel that runs through the Alps in southern Switzerland. The tunnel is 9.3 miles (15 kilometers) long and lies 4,000 feet (1,200 meters) above sea level. It provides an easy and scenic crossing of the Lepontine Alps by way of Zurich, Switzerland, and Milan in northern Italy. For location, see SWITZERLAND (color map).

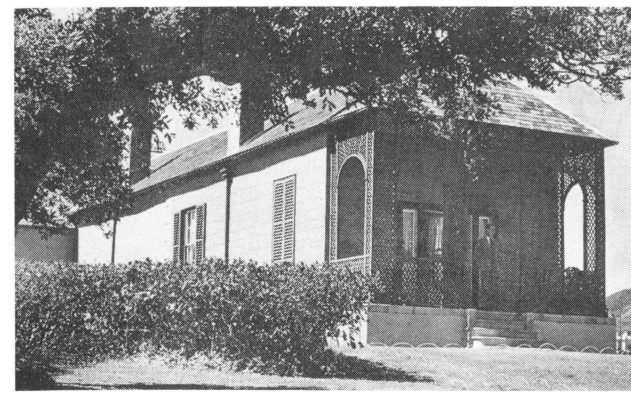
Construction of the tunnel began in 1872, and it was completed in 1888. Workmen were hampered by extensive illness, high temperatures in the tunnel, water rushing into the tunnel, and collapsing walls. JACK R. VILLMOW

SAINT HELENA, *saynt huh LEE nuh,* is a British island in the Atlantic Ocean. It lies about 1,200 miles (1,930 kilometers) off the southwest coast of Africa, and about 700 miles (1,100 kilometers) southeast of Ascension Island, which is the nearest land (see ATLANTIC OCEAN [map]). Saint Helena is famous because Napoleon Bonaparte was forced to live there from 1815 until his death in 1821 (see NAPOLEON I). The Portuguese discovered Saint Helena in 1502, but it has belonged to Britain since 1673. It serves as the administrative center for certain other British islands in the southern part of the Atlantic Ocean. These include Ascension Island and the Tristan da Cunha group, which consists of Tristan da Cunha, Gough, Inaccessible, and Nightingale islands.

Saint Helena is rough and mountainous. It covers 47 square miles (122 square kilometers) of lonely, volcanic wasteland. Barren cliffs rise 1,000 feet (300 meters) above sea level. The only village and port is Jamestown, the island capital. It lies at the mouth of a small mountain stream near James Bay. Saint Helena has a population of about 5,000. The people are Europeans, East Indians, and Africans.

Less than a third of Saint Helena can be used for raising crops. The chief crop is New Zealand flax. Grasslands where cattle and sheep graze cover part of the island. The government has helped set up factories to make fiber mats. Other industries include fish curing and lacemaking. H. F. RAUP

See also ASCENSION; JAMESTOWN.



Camera Press, Pix

Longwood, Napoleon's Home in Exile, stands near Jamestown on St. Helena Island. Napoleon lived there from 1815 to 1821.

SAINT HELENS, MOUNT. See WASHINGTON (Land Regions).

SAINT JAMES'S PALACE is a royal mansion in London, England. It stands in Westminster, north of the Mall (see LONDON [Map of Inner London]). The palace served as the official London residence of the British sovereign until 1837. At that time, Queen Victoria moved the royal residence to Buckingham Palace. The British court is still officially known as "The Court of St. James's." Henry VIII built the palace in 1532.

SAINT JOHN. See VIRGIN ISLANDS.

SAINT JOHN (pop. 89,039; met. area 106,744) is the largest city and leading industrial center of New Brunswick. It also ranks as a major Canadian port. Saint John Harbor remains open all winter, when ice closes Canada's inland ports. The city lies on the Bay of Fundy, at the mouth of the St. John River. For location, see NEW BRUNSWICK (political map).

Saint John is called the *Loyalist City* because it was founded by Americans known as United Empire Loyalists. These people had supported Great Britain during the Revolutionary War in America. In 1783, about 4,000 of them sailed from New England to the site of Saint John, where they had been granted land because of their loyalty to Britain. In 1785, the Loyalist communities of Parrtown and Carleton merged to form

Saint John, which then became the first incorporated city in Canada. The city was named for the St. John River. The French explorer Samuel de Champlain had named the river in honor of Saint John the Baptist. Champlain reached the waterway on the saint's feast day, June 24, in 1604.

Description. Saint John covers about 140 square miles (363 square kilometers). Much of the city lies on peninsulas. Saint John is the home of the New Brunswick Museum, the oldest museum in Canada. This museum was established in 1842. Saint John also has a branch campus of the University of New Brunswick.

The city's most famous tourist attraction is the Reversing Falls, at the mouth of the St. John River. Here, high tides from the Bay of Fundy force the river backwards through the falls twice a day. Historic attractions in Saint John include the Martello Tower, a stone fortification built during the War of 1812; and the Loyalist House, a home completed in 1817.

Saint John has about 80 manufacturing plants, which employ about a fifth of the city's workers. The main industries include oil refining, pulp and paper manufacturing, shipbuilding, and sugar refining. The Port of Saint John handles about 6 million short tons (5.4 million metric tons) of cargo yearly. An offshore terminal nearby serves huge oil tankers. Two railroads provide freight and passenger service for the city. Airlines use Saint John Municipal Airport.

Government and History. Saint John has a council-manager form of government. The voters elect a mayor and the 12 councilmen to three-year terms. An appointed city manager serves as the chief administrative official of the city government.

Maliseet Indians lived in what is now the Saint John area before white men arrived. By 1631, French fur traders had built a fort there. Rival French traders and the British fought over the area. The British finally won control in 1755.

George Hunter, Miller Services

Saint John is the largest city and chief industrial center of New Brunswick. The city also ranks as one of Canada's most important Atlantic Coast ports.

The area remained largely a wilderness until the United Empire Loyalists arrived in 1783. Many of the early residents built or operated wooden sailing ships. By the mid-1800's, Saint John had one of the world's largest merchant fleets. During the late 1800's, the increasing use of iron steamships led to the decline of Saint John's sailing-ship industry. The Great Fire of 1877 destroyed much of the city, but the people quickly rebuilt Saint John. By 1900, the city had a population of about 40,000.

The 1960's brought a new period of growth to Saint John. Corporations established or expanded many large facilities, including an oil refinery, paper mills, ship terminals, and shipyards. The federal and provincial governments encouraged industrial growth by providing financial aid to businesses. In 1969, the city's population jumped from 51,567 to 89,039 when Saint John merged with the city and the parish of Simonds.

In 1974, a major modernization program began in downtown Saint John with a project called Brunswick Square. This $42-million development included construction of a department store, a hotel, and a 33-story office building. Brunswick Square was scheduled for completion in 1977. FRED HAZEL

For the monthly weather in Saint John, see NEW BRUNSWICK (Climate). See also NEW BRUNSWICK (pictures).

SAINT JOHN FISHER COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT JOHN LATERAN. See LATERAN.

SAINT JOHN RIVER is the main waterway of New Brunswick, Canada. It is 390 miles (628 kilometers) long, and drains more than 21,500 square miles (55,680 square kilometers). The Saint John is formed by several small streams that rise on or near the boundary between Quebec and Maine. The river flows northeast to cross the northwest corner of Maine, then forms the boundary between Maine and New Brunswick. After the river enters New Brunswick, it continues south for over 200 miles (320 kilometers), and empties into the Bay of Fundy.

The Saint John, often called the *Rhine of America*, is one of the most beautiful rivers in the Atlantic Provinces. Three miles (5 kilometers) after it enters New Brunswick, it plunges over Grand Falls, a drop of 75 feet (23 meters). The river drops the same distance in the rapids that extend for nearly 1 mile (1.6 kilometers) below the falls. Small boats can travel about 260 miles (418 kilometers) up the St. John. Near its mouth are the Reversing Falls of Saint John (see REVERSING FALLS OF SAINT JOHN). W. S. MACNUTT

SAINT JOHN THE DIVINE, CATHEDRAL OF, in New York City, is the world's largest Gothic cathedral. It stands between 110th and 113th streets, near Broadway. The cornerstone was laid on Dec. 17, 1892. Builders partly finished this Episcopal church in a combination of Byzantine, Romanesque, and Gothic styles. In 1911, plans were changed to copy late Gothic styles. Construction methods, such as using stone rather than reinforced concrete, follow medieval customs. Work continues on the unfinished cathedral. G. HOLMES PERKINS

See also RELIGION (color picture: Christianity).

National Film Board

Saint John's Stands on This Deep, Well-Sheltered Harbor, Which Can Accommodate Oceangoing Ships.

SAINT JOHN'S, Newfoundland (pop. 88,102; met. area 131,814), is the capital and largest city of the province. St. John's lies on a deep, well-sheltered harbor near a rich fishing area called the Grand Banks. For location, see NEWFOUNDLAND (political map). This location has made the city a busy port where fishing ships of many countries dock to make repairs and take on supplies. St. John's also serves as the commercial, cultural, and educational center of Newfoundland.

The explorer John Cabot was probably the first European to visit the area that is now St. John's. Historians believe he entered the harbor in 1497. They also believe Cabot named the site for Saint John the Baptist because he arrived there on the saint's feast day, June 24. St. John's ranks as one of the oldest inhabited areas in North America. European fishermen built a number of dwellings there in the early 1500's. They chose the site for its fine natural harbor and rich fishing waters.

St. John's lies closer to Europe than any other major North American city. As a result, it has played a part in several historic events. In 1901, for example, the Italian inventor Guglielmo Marconi received the first transatlantic wireless signal on Signal Hill in St. John's. In 1919, the British fliers John Alcock and Arthur Whitten-Brown took off from St. John's on the first nonstop flight across the Atlantic.

Description. St. John's covers 13 square miles (34 square kilometers) on the Avalon Peninsula at the southern end of the island of Newfoundland. Most of the downtown area lies on hills that slope up from the waterfront. The city's landmarks include the Confederation Building, which houses the Newfoundland government, and the Memorial University of Newfoundland, the province's only university.

The Newfoundland Museum preserves a skeleton and a mummy of the Beothuk Indians, a tribe that once lived on the island. The Arts and Culture Centre includes a museum of ships and sailing, an art gallery, and a theater. Signal Hill, now part of Signal Hill National Historic Park, offers a good view of St. John's.

About a fourth of St. John's workers have jobs in wholesale or retail trade. Many of the city's people work in federal, provincial, or local government agencies. The harbor of St. John's has been called the "service station of the North Atlantic." Fishing ships stop there for repairs and to take on supplies of bait, food, and water. The Trans-Canada Highway runs between St. John's and Victoria, B.C. The St. John's Airport lies 3 miles (5 kilometers) from the city at Torbay.

Government and History. St. John's has a mayor-council form of government. The voters elect the mayor and eight councilmen to four-year terms.

Beothuk Indians probably lived in the St. John's area before Europeans arrived. European fishermen started coming to St. John's during the 1500's, shortly after John Cabot discovered the nearby fishing grounds. England claimed possession of Newfoundland in 1583. The Dutch attacked St. John's in 1665, and the French captured it in 1696, 1708, and 1762. But the English recaptured the settlement each time.

During the Revolutionary War in America (1775-1783) and the War of 1812, the British made St. John's a major naval base. In the 1800's, the settlement became a center for sailmaking, shipbuilding, and drying

and smoking fish. St. John's had a population of about 30,000 when it was incorporated as a city in 1902.

Many of the city's industries suffered during the Great Depression of the 1930's. But during World War II (1939-1945), both Canada and the United States had major military bases in the area. These bases brought new jobs and thousands of people to St. John's.

Newfoundland became a province in 1949, with St. John's as its capital. By 1951, the city had a population of 53,000. After St. John's became a provincial capital, the federal and provincial governments established many agencies there. New buildings were erected to house these agencies. The Confederation Building opened in 1959 and a new City Hall in 1970. In 1971, St. John's started a 20-year urban renewal project called Plan '91. This project includes construction of a cross-town highway. MICHAEL F. HARRINGTON

For St. John's monthly weather, see NEWFOUNDLAND (Climate). See also NEWFOUNDLAND (pictures).

SAINT JOHN'S-BREAD. See CAROB.

SAINT JOHN'S COLLEGE, Calif. See UNIVERSITIES AND COLLEGES (table).

SAINT JOHN'S COLLEGE is a private, coeducational, liberal arts school. Its main campus is in Annapolis, Md. In 1964, a branch campus opened in Santa Fe, N.Mex.

The college's course of study is unusual. Instead of textbooks, students read more than 125 books by the world's greatest thinkers. For example, they read Plato and Aristotle, the Bible and St. Thomas Aquinas, Locke and Rousseau, and Darwin and Freud. They discuss the books in evening classes called *seminars*. There are no faculty departments and no majors. Students study English, foreign languages, mathematics, and music in classes called *tutorials*. Tutorials emphasize discussion. Students also study science in laboratories for four years. St. John's grants a B.A. degree.

Saint John's College was founded as King William's School, an academy, in 1696. It was chartered as a college in 1784. For enrollment, see UNIVERSITIES AND COLLEGES (table). RICHARD D. WEIGLE

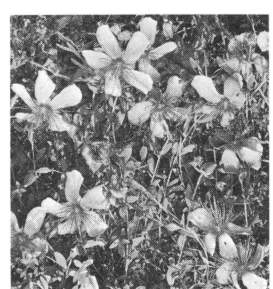
SAINT JOHNS RIVER. See FLORIDA (Rivers, Lakes, and Springs).

SAINT JOHN'S SEMINARY. See UNIVERSITIES AND COLLEGES (table).

SAINT JOHN'S UNIVERSITY, Minn. See UNIVERSITIES AND COLLEGES (table).

SAINT JOHN'S UNIVERSITY, N.Y. See UNIVERSITIES AND COLLEGES (table).

SAINT JOHN'S-WORT, or HYPERICUM, is a handsome shrub with large yellow flowers. Gardeners often use it for borders. Most Saint John's-worts grow in the temperate and warmer regions of the Northern Hemisphere. They are usually low shrubs. Some are evergreen. The flowers bloom in clusters during the summer. Pink and purplish flowers are rare. These bushes grow well in loam or moist, sandy soil. Most of them should have some shade. The larger Saint John's-worts form rounded bushes when they grow alone. The smaller Saint John's-worts make good low borders or ground cover. The goldflower is a hybrid. There are over 300 known *species* (kinds) of Saint John's-worts.



J. Horace McFarland

Saint John's-Wort

Scientific Classification. The Saint John's-wort belongs to the Saint John's-wort family, *Hypericaceae*. The goldflower is classified as genus *Hypericum*, species *H. moserianum*. ALFRED C. HOTTES

SAINT JOHNSBURY, Vt. (pop. 8,409), is the largest community in northeastern Vermont. It is about 30 miles (48 kilometers) northeast of Montpelier, on the Passumpsic and Moose rivers (see VERMONT [political map]). Saint Johnsbury is the home of a million-dollar maple sugar processing industry. Other manufactures include wood products and machinery. The manufacture of weighing scales began in 1831, when Thaddeus Fairbanks invented the platform scale there. Saint Johnsbury is the seat of Caledonia County, and has a council-manager form of government. Saint Johnsbury was settled in 1786. WALTER R. HARD, JR.

SAINT JOSEPH, Mo. (pop. 72,691; met. area 98,828), is the trading center for a large fruit, livestock, and grain-producing region. The city lies on the east bank of the Missouri River in the northwest part of Missouri, 55 miles (89 kilometers) northwest of Kansas City. For location, see MISSOURI (political map).

St. Joseph has the largest plant in the United States for producing cholera serum for hogs. One of America's largest paper-tablet and stationery factories is located in St. Joseph. The city has one of the largest livestock and meat-packing industries in the state. It is an important flour and cereal milling center. Many dry-goods concerns operate in the city.

Manufacturing plants make textiles, clothing, candy, beverages, dairy goods, harnesses and saddles, chemicals, drugs, paper boxes, and iron goods. The city is the transportation center for northwest Missouri. It is the home of Missouri Western College.

The city was founded in 1826 by Joseph Robidoux, a French fur trader. It received a city charter in 1851. The city has a mayor-council form of government. In 1860, the pony express began operating between Saint Joseph and Sacramento, Calif. (see PONY EXPRESS). Jesse James, a famous western outlaw, was killed in Saint Joseph in 1882. NOEL P. GIST

SAINT JOSEPH COLLEGE. See UNIVERSITIES AND COLLEGES (table).

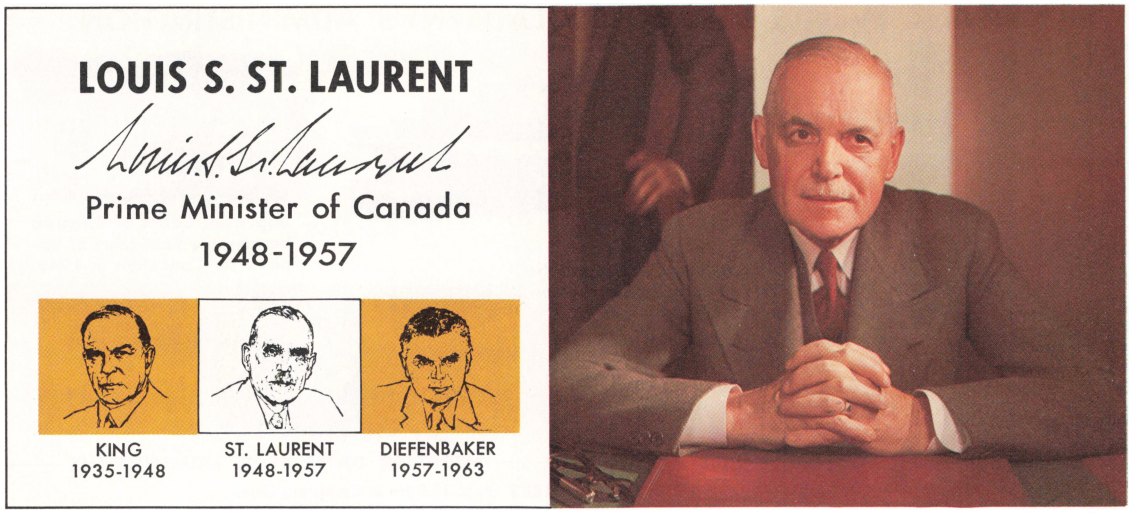
SAINT JOSEPH SEMINARY COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT JOSEPH'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT JOSEPH'S SEMINARY AND COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT KITTS-NEVIS-ANGUILLA. See WEST INDIES ASSOCIATED STATES.

SAINT-LAURENT, *SAN LAW RAHN*, Quebec (pop. 62,955), is a suburb of Montreal, about 3 miles (5 kilometers) northwest of the city (see QUEBEC [political map]). It produces iron and steel products, transportation equipment, and chemicals. Basile Moreau and Sainte-Laurent colleges are located there. St.-Laurent was founded in 1845 and became a city in 1954. It has a mayor-council government. HUBERT CHARBONNEAU



Karsh, Ottawa

SAINT LAURENT, *san law RAHN*, **LOUIS STEPHEN** (1882-1973), served as Prime Minister of Canada from 1948 to 1957. He was the second French Canadian to hold the office. Like Sir Wilfrid Laurier, the first French-Canadian Prime Minister, St. Laurent was a Liberal.

Under St. Laurent's leadership, Canada took an increasingly important part in world affairs. St. Laurent was one of the chief architects of the North Atlantic Treaty Organization (NATO), a military alliance of 15 Western nations. In 1949, Canada dropped the word "Dominion" from its name, but maintained its relationship with Britain in the British Commonwealth of Nations. Also in 1949, Newfoundland became the 10th Canadian province. St. Laurent, who was half Irish and half French, considered his outstanding contribution to be the promotion of greater understanding and cooperation between English-speaking Canadians and French-speaking Canadians.

Louis St. Laurent entered public service unusually late in life. He was 59 years old when he became Canada's minister of justice and 66 when he took office as Prime Minister. He had already earned a reputation as an outstanding lawyer. Many Canadians thought St. Laurent was too modest and reserved to be an effective politician. But he led the Liberals to victory with overwhelming majorities in the 1949 and 1953 elections.

A lean, quick-moving man, St. Laurent had a shy manner and a friendly smile. He had piercing black eyes, white hair, and a neat white mustache. St. Laurent spoke French and English equally well. When he used English, listeners could hear a trace of Irish brogue. St. Laurent's gestures, particularly an expressive hunch of the shoulders, were French.

Early Life

Boyhood and Education. Louis S. St. Laurent was born on Feb. 1, 1882, in the town of Compton, Que., a little north of the Canadian border with Vermont. He was one of the six children of Jean Baptiste Moïse St. Laurent, a storekeeper, and Ann Mary Broderick St. Laurent, a former schoolteacher. His father was descended from French settlers. His mother's parents were Irish immigrants. Louis grew up learning to speak French with his father and English with his mother.

As a boy, Louis became keenly interested in politics. His political hero was Wilfrid Laurier. During the 1896 election, the wall telephone in his father's store was the town's only source of election news. Louis enthusiastically relayed bulletins as they brought the news that Laurier and the Liberals had won.

During the 1900 election, Louis was in college. He could not leave his dormitory after a certain hour, so he lowered a pail from his window and hauled up election bulletins. In 1903, while studying law, St. Laurent reported Quebec politics for the *Sherbrooke Record*. He took the job so he could watch the Quebec parliament in action from the press gallery.

St. Laurent attended St. Charles Seminary in Sherbrooke, Que., and received a bachelor's degree in 1902. He then studied law at Laval University in Quebec and earned his law degree in 1905. St. Laurent refused the offer of a Rhodes Scholarship to Oxford University because he wanted to begin practicing law immediately. He went to work in a Quebec law office for a salary of $50 a month.

Marriage. In 1906, St. Laurent met Jeanne Renault (1886-1966), the daughter of a Beauceville East, Que., businessman. She later recalled: "As soon as I saw Louis, I said to myself, 'That's the man I'm going to marry.' " She and St. Laurent were married in May, 1908. They had two sons and three daughters. Both sons became lawyers. One of them, Jean Paul, served in parliament from 1955 to 1958.

Lawyer. St. Laurent quickly earned a reputation as a brilliant lawyer. In 1914, he became a professor of law at Laval University. He served as president of the Canadian Bar Association from 1930 to 1932. St. Laurent ranked as one of the top Canadian authorities on constitutional law. From 1937 to 1939, he served as senior counsel of the Royal Commission on federalism.

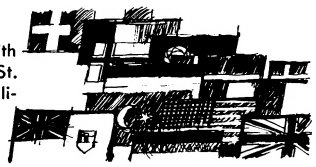
Entry Into Public Life

In November, 1941, minister of justice Ernest Lapointe died. He had been the principal voice of French-Canadians in the Liberal party. Prime Minister Mac-

IMPORTANT EVENTS DURING ST. LAURENT'S ADMINISTRATION

National Film Board

Heading Canada's Delegation to the United Nations in 1947, St. Laurent, *left*, conferred with alternate delegate Lester B. Pearson.



NATO was set up in 1949 with Canada as a member. St. Laurent helped form the alliance.

Supreme Court of Canada became the final court of appeals for Canadians in 1949.

Vincent Massey became the first Canadian-born governor-general of Canada in 1952.

by Hans Zander for WORLD BOOK

IMPORTANT DATES IN ST. LAURENT'S LIFE

1882 (Feb. 1) Born in Compton, Que.
1908 (May 19) Married Jeanne Renault.
1930 Elected president of Canadian Bar Association.
1941 (Dec. 10) Became minister of justice.
1942 Elected to parliament.
1946 (Sept. 4) Appointed secretary of state for external affairs.
1948 (Aug. 7) Elected leader of Liberal party.
1948 (Nov. 15) Became Prime Minister of Canada.
1949 Great Britain gave Canada the power to amend its own constitution.
Newfoundland became Canada's 10th province.
1957 (June 21) Resigned as Prime Minister.
1958 (January) Resigned as Liberal party leader.
1973 (July 25) Died in Quebec City.

kenzie King asked the 59-year-old St. Laurent to take Lapointe's place. St. Laurent agreed "as a matter of patriotic duty" to serve for the duration of World War II. He took office as minister of justice on Dec. 10, 1941.

As wartime minister of justice, St. Laurent encouraged unity between English- and French-Canadians by supporting *conscription* (drafting men for military service). During World War I, English-Canadians had favored conscription but French-Canadians had hotly opposed it (see BORDEN, SIR ROBERT LAIRD [Conscription Crisis]). In February, 1942, St. Laurent won election to Lapointe's old parliament seat from Quebec East. He was re-elected in 1945. After World War II ended in 1945, St. Laurent wanted to return to private life. But King persuaded him to stay in office.

On Sept. 4, 1946, King named St. Laurent secretary of state for external affairs. In 1946 and 1947, St. Laurent led the Canadian delegations to the UN General Assembly in London and New York City.

In 1948, Prime Minister King announced his plans to retire. He urged the Liberal party to name St. Laurent as his successor as party leader. On Aug. 7, 1948, St. Laurent was elected leader of the Liberal party.

Prime Minister (1948-1957)

At the age of 66, Louis St. Laurent took office as Prime Minister of Canada on Nov. 15, 1948. During his term, Canada's international reputation soared. St. Laurent realized that Canada would have to adopt a more international outlook than ever before. He and his minister of external affairs, Lester B. Pearson, led in forming the North Atlantic Treaty Organization.

In 1949, Great Britain granted the Canadian parliament the power to amend Canada's constitution in matters pertaining to the federal government. Previously, only the British parliament had made amendments to the Canadian constitution. Also in 1949, the Supreme Court of Canada became the final court of appeals for Canadians. Until this time, Canadian legal appeals had gone to the Privy Council in England.

In 1952, upon St. Laurent's recommendation, Vincent Massey became the first Canadian-born governor-general of Canada (see MASSEY, VINCENT). St. Laurent explained his choice: "I would not like to think that a Canadian, alone of the Queen's subjects, would not be considered to represent the Queen in Canada."

After being in power for 22 years, the Liberals lost the election of June, 1957. They won only 105 seats in parliament, compared to 112 for the Progressive Conservatives and 44 for other parties. The Progressive Conservatives took over the government and John G. Diefenbaker became Prime Minister. The defeat of the Liberals resulted partly from a rising new national spirit in Canada which the energetic Diefenbaker seemed to represent.

St. Laurent was re-elected to parliament. But he did not seek re-election after parliament was dissolved on Feb. 1, 1958. St. Laurent retired as party leader in January, 1958, and Pearson succeeded him.

Retirement and Death

In 1958, St. Laurent returned to the practice of law in Quebec. He also lectured on law at Laval University and served on the boards of several large Canadian corporations. St. Laurent did not withdraw completely from political life. He continued to speak publicly on behalf of the Liberal party. St. Laurent was largely confined to his home in Quebec City after breaking a hip in 1968. He died in his home on July 25, 1973. St. Laurent was buried in Compton.

WILFRID EGGLESTON

Related Articles in WORLD BOOK include:

Canada, Government of
Canada, History of
Diefenbaker, John George
King, William Lyon Mackenzie
Laurier, Sir Wilfrid
Pearson, Lester Bowles
Political Party (Political Parties in Canada)

SAINT LAWRENCE, GULF OF. See GULF OF SAINT LAWRENCE.

SAINT LAWRENCE ISLANDS NATIONAL PARK. See CANADA (National Parks).

SAINT LAWRENCE RIVER

The Saint Lawrence River is the largest river in Canada. It drains the Great Lakes and flows into the Gulf of St. Lawrence. Many smaller rivers and streams flow into it. The tide of the Atlantic Ocean extends up the river as far as Trois-Rivières, Que.

Distance scale
0 100 200 Miles
0 100 200 300 Kilometres

WORLD BOOK map

SAINT LAWRENCE RIVER is the largest river in Canada and one of the largest rivers in the world. It is often called the *Mother of Canada*. Its wide, deep course was the first highway of the explorers, fur traders, and colonists who came to Canada in early days.

Some authorities estimate that the Saint Lawrence is second only to the Amazon in the amount of water it pours into the ocean every day. It drains over 500,000 square miles (1,300,000 square kilometers), including the Great Lakes and southeastern Canada.

Sources. The Saint Lawrence begins at the northeast end of Lake Ontario and flows northeastward until it enters the Gulf of Saint Lawrence. But the source of this vast river system is the Saint Louis River, which rises in northeastern Minnesota and enters into Lake Superior at Duluth. The Saint Marys River connects Lake Superior to Lake Huron. The Saint Clair and Detroit rivers connect lakes Huron and Erie. And the Niagara River with its great falls and rapids connects lakes Erie and Ontario. The Saint Lawrence River proper from Lake Ontario to its mouth in the Gulf of Saint Lawrence is 710 miles (1,143 kilometers) long. The Greater Saint Lawrence River—from the head of its most distant source, the Saint Louis River, to the Gulf—is about 1,900 miles (3,060 kilometers) long.

Many smaller streams empty into the Saint Lawrence. They include the Ottawa River, which enters from the north at the island of Montreal (see OTTAWA RIVER). Other branches that enter from the north include the Saint Maurice River, which is noted for its high falls; the Montmorency River, famed for its cascade; and the Saguenay. From the south, the Saint Lawrence receives the Saint Regis, which rises in the foothills of the Adirondacks. The Richelieu, which is the outlet for Lake Champlain, the Chaudière, and several less important streams also enter the Saint Lawrence from the south.

General Description. The Saint Lawrence has an average width of 1¼ miles (2 kilometers) as it flows from Lake Ontario to Quebec. In some places, the great river narrows to less than 1 mile (1.6 kilometers), but in others it expands to form "lakes." The most famous of these lakes are Lake Saint Francis, a 30-mile (48-kilometer) long stretch of water above Montreal, and Lake Saint Peter, 28 miles (45 kilometers) long, which is located halfway between Montreal and Quebec. The channel of the Saint Lawrence slowly broadens below Quebec to form the great *estuary* (sunken river mouth) that blends with the Gulf of Saint Lawrence at Anticosti Island. Below the Île d'Orléans, the channel of the river is never less than 10 miles (16 kilometers) wide. The river is 25 miles (40 kilometers) wide where the Saguenay empties into it, and opposite Gaspé, it is 90 miles (145 kilometers) wide.

The river drops 245 feet (75 meters) between Lake Ontario and the city of Quebec. Most of this fall is above the city of Montreal. Between Lake Ontario and Montreal, there are about 30 miles (48 kilometers) of rapids. The tide goes up the Saint Lawrence River as far as the Saint Maurice River, at Trois-Rivières. There, the water may rise as high as 19 feet (5.8 meters). The rise at Quebec is nearly as great.

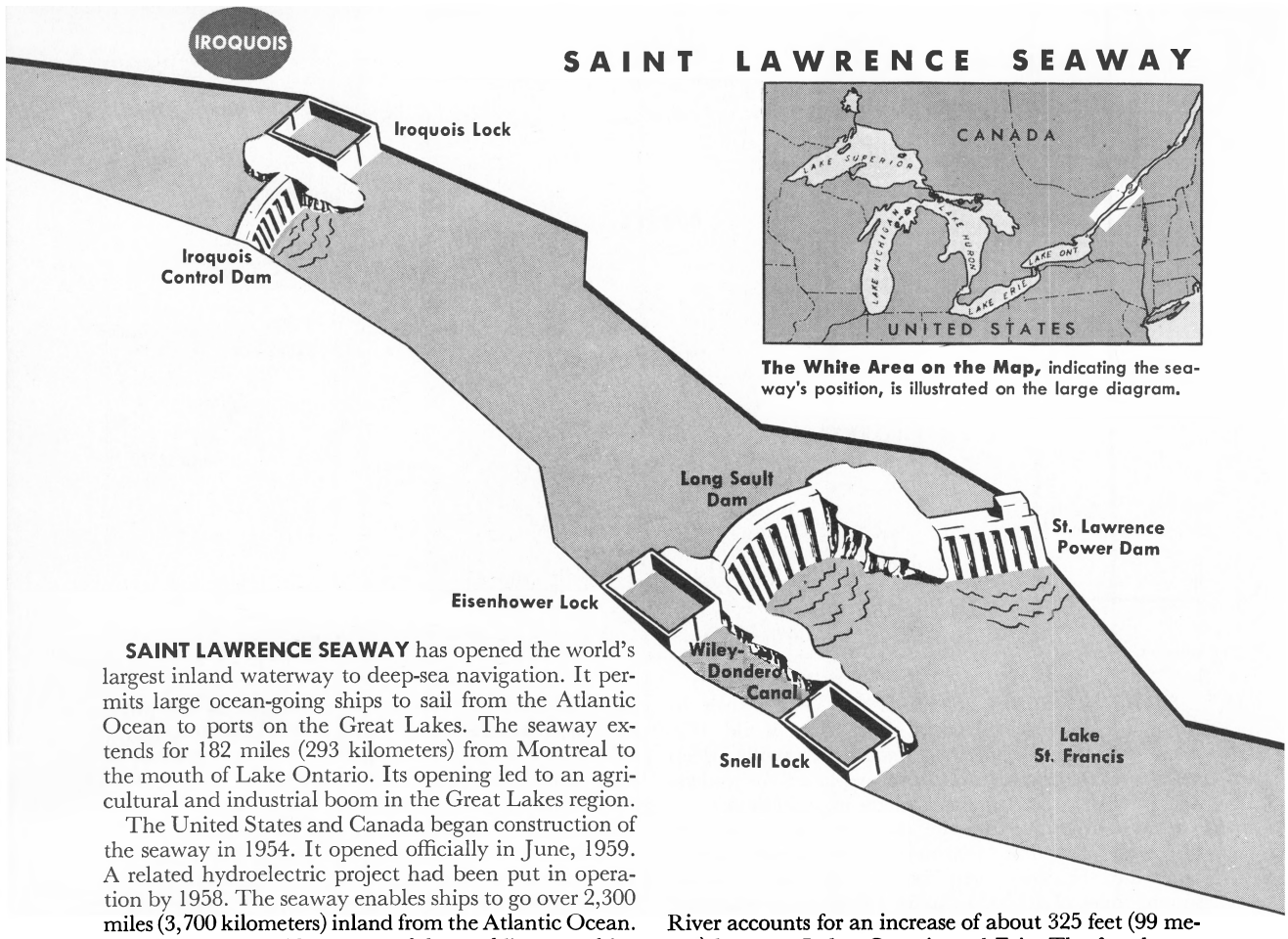
Bad floods on the Saint Lawrence are unknown, because the waters of the Great Lakes do not rise and fall suddenly. Mud and silt that flow into the Great Lakes settle to the bottom, leaving the Saint Lawrence clean. However, the lakes and river have recently been polluted by sewage, industry, and ship wastes.

Low water levels and pollution have caused many problems along the Saint Lawrence. In the 1960's and 1970's, the International Joint Commission, a United States-Canadian agency, conducted studies of these problems.

WILLIAM R. WILLOUGHBY

Related Articles in WORLD BOOK include:

Great Lakes
Gulf of Saint Lawrence
Lake Saint Lawrence
Ontario (picture: Thousand Islands)
River (chart)
Saint Lawrence Seaway
Thousand Islands



The White Area on the Map, indicating the seaway's position, is illustrated on the large diagram.

SAINT LAWRENCE SEAWAY has opened the world's largest inland waterway to deep-sea navigation. It permits large ocean-going ships to sail from the Atlantic Ocean to ports on the Great Lakes. The seaway extends for 182 miles (293 kilometers) from Montreal to the mouth of Lake Ontario. Its opening led to an agricultural and industrial boom in the Great Lakes region.

The United States and Canada began construction of the seaway in 1954. It opened officially in June, 1959. A related hydroelectric project had been put in operation by 1958. The seaway enables ships to go over 2,300 miles (3,700 kilometers) inland from the Atlantic Ocean. By using it, about 80 per cent of the world's cargo ships can now sail as far west as Lake Superior.

Saint Lawrence System

The vast Saint Lawrence River system has its source in the Saint Louis River in northeastern Minnesota. The system follows the Great Lakes to the northeastern end of Lake Ontario. Here, the Saint Lawrence River itself begins. It flows northeast until it enters the Gulf of Saint Lawrence and flows into the Atlantic Ocean.

William R. Willoughby, the contributor of this article, is Professor of Political Science at the University of New Brunswick and author of The St. Lawrence Waterway.

Before the seaway was completed, most of the waterway was deep enough for navigation. All but the largest ocean ships could sail for more than 1,000 miles (1,600 kilometers) from the Atlantic to Montreal. Lake ships could sail another 1,000 miles from Ogdensburg, N.Y., to Lake Superior.

However, navigation was hampered by five changes in elevation. These changes raise the waters from sea level at the ocean to about 600 feet (180 meters) above sea level at Lake Superior. The first step is a minor 20-foot (6.1-meter) increase in the 1,000 miles (1,600 kilometers) below Montreal. Then, the upper Saint Lawrence River from Montreal to Lake Ontario jumps 225 feet (69 meters) in 182 miles (293 kilometers). This area includes the Thousand Islands section. The Niagara River accounts for an increase of about 325 feet (99 meters) between Lakes Ontario and Erie. The fourth step is a 9-foot (2.7-meter) rise on the Detroit and Saint Clair rivers. The fifth is a 21-foot (6.4-meter) step on the Saint Marys River, between Lakes Huron and Superior.

Canals. Canada completed the Welland Ship Canal in 1932. The 27-mile (43-kilometer) canal has eight locks between Lakes Erie and Ontario. The United States and Canadian Soo Canals permit ships to pass between Lakes Superior and Huron. During the late 1800's, Canada built a series of canals in what is now the Saint Lawrence Seaway area. These canals overcame the drop caused by rapids and falls between Montreal and Ogdensburg, N.Y. The canals extended for 46 miles (74 kilometers) and had 22 locks, each 44 feet (13 meters) wide. Until the 1950's, these narrow locks restricted the channel to ships with a capacity under 3,000 short tons (2,700 metric tons). The United States and Canada began the Saint Lawrence Seaway in 1954 to remove this bottleneck.

Navigation Project. The United States' share of the seaway has included digging the Wiley-Dondero Canal in the International Rapids section near Massena, N.Y. The canal is 8 miles (13 kilometers) long. It has two locks, the Dwight D. Eisenhower and the Bertrand H. Snell. Each is 80 feet (24 meters) wide. The United States has also dredged the Thousand Islands section to a 27-foot (8.2-meter) depth. Between 1957 and 1964, the United States deepened the connecting channels of the Great Lakes to this same depth. Shippers have

urged that the channels be deepened to 35 feet (11 meters).

Canada has built a short canal and lock to bypass the Iroquois Control Dam. Canada has also constructed canals with five locks. The Côte Ste. Catherine and St. Lambert locks are on the South Shore Canal, and two Beauharnois locks were built near Montreal. The Iroquois Lock is near Iroquois, Ontario. The Canadian locks are identical to those of the United States in size and depth. The Canadians also deepened the Welland Canal and dredged the section between Cornwall, Ontario, and Montreal.

The United States spent $130 million for its share of the navigation project. The U.S. Army Corps of Engineers directed the construction, under the supervision of the Saint Lawrence Seaway Development Corporation. Canada spent $366\frac{1}{2}$ million. The Saint Lawrence Seaway Authority of Canada directed the Canadian construction. Tolls were fixed by Canadian-United States agreement to pay off bonds.

Power Project. New York state and the province of Ontario began the power project in August, 1954. The state and province paid equal shares of the $600 million cost. About 38,000 acres (15,400 hectares) of farmland were flooded to create a lake 28 miles (45 kilometers) long in the Massena, N.Y.-Cornwall, Ont., region.

Malak, Miller Services

The St. Lambert Lock at Montreal plays an important role in the Saint Lawrence Seaway. It is one of seven locks that help ocean-going ships travel between Montreal and Lake Ontario.

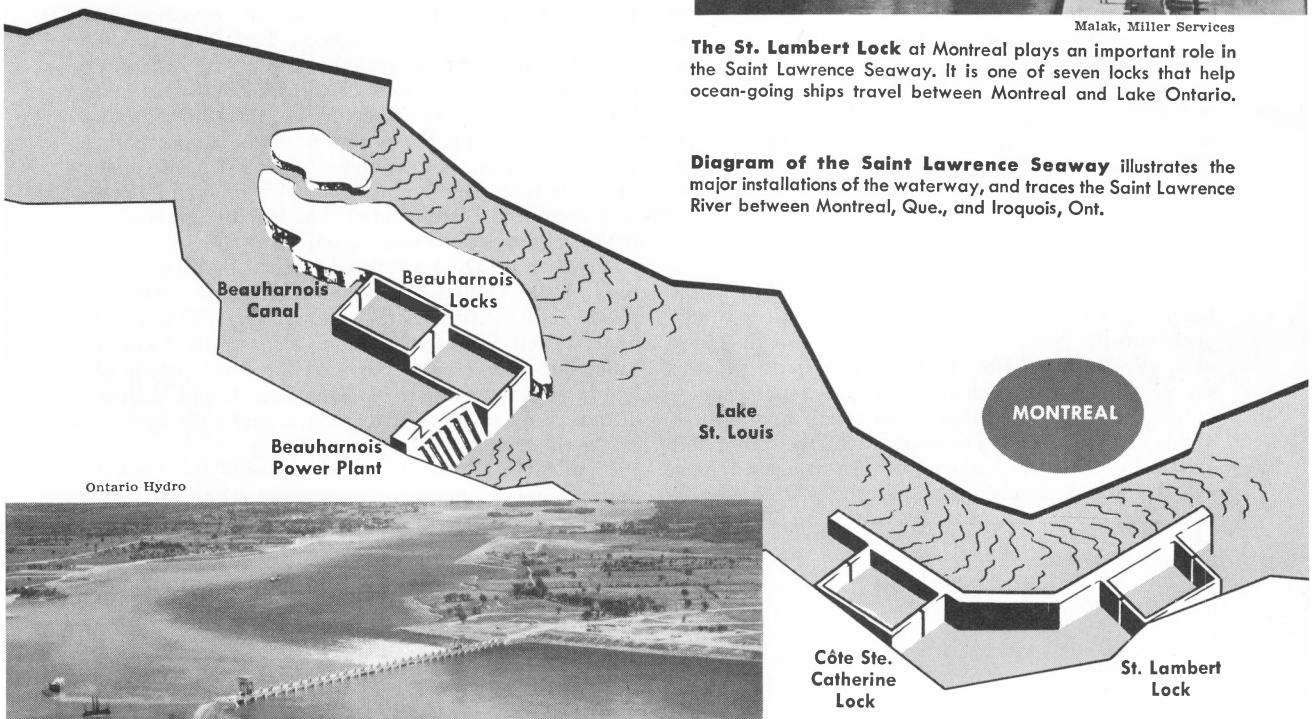
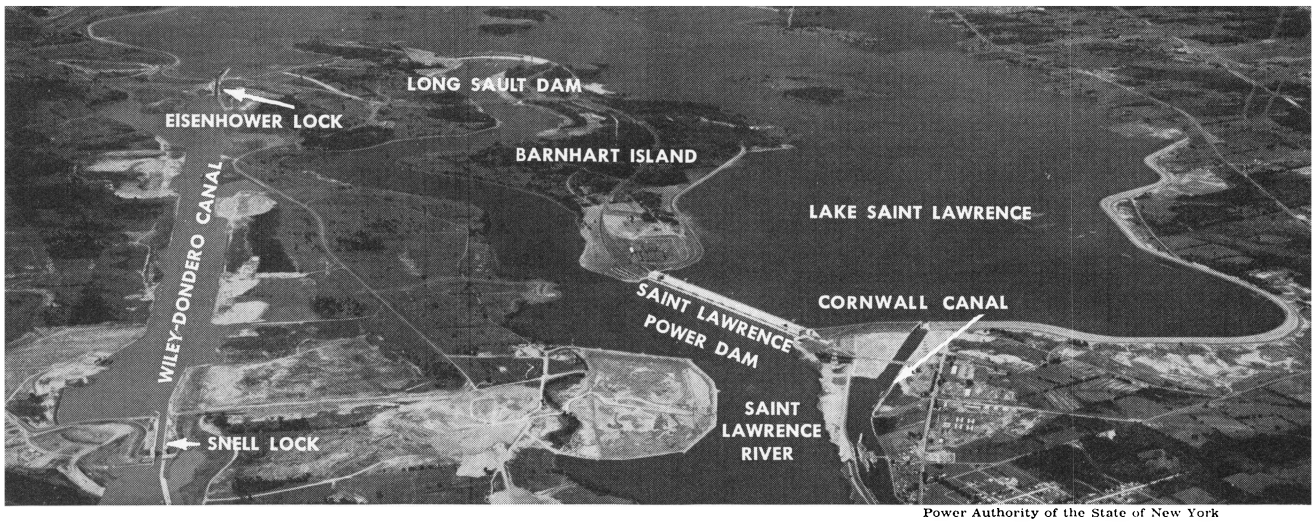


Diagram of the Saint Lawrence Seaway illustrates the major installations of the waterway, and traces the Saint Lawrence River between Montreal, Que., and Iroquois, Ont.

Ontario Hydro

The Iroquois Control Dam, *center,* crosses the Saint Lawrence between Canada and the United States, near the Iroquois Lock, *left foreground.*



Power Authority of the State of New York

Lake Saint Lawrence was created by waters confined by the Saint Lawrence Power and Long Sault dams. The dams flooded an area between Massena, N.Y., and Cornwall, Ont. Ships go through the Snell and Eisenhower locks, and the Wiley-Dondero Canal.

Seven Canadian towns and part of an eighth were also flooded. Four new communities were created nearby for the residents. The power project includes a powerhouse dam, a spillway dam, and a control dam. The powerhouse dam, called Robert Moses-Robert H. Saunders St. Lawrence Power Dam, stretches between the eastern end of Barnhart Island and the Canadian mainland. The spillway dam (Long Sault Dam) extends across the south channel from Barnhart Island to the U.S. mainland. The Iroquois Control Dam is 25 miles (40 kilometers) upstream from the Long Sault Dam.

The Power Authority of New York directed the state's share of the construction. The Hydro-Electric Power Commission of Ontario supervised the province's share. The project produces about 12,600,000,000 kilowatt-hours of electricity annually.

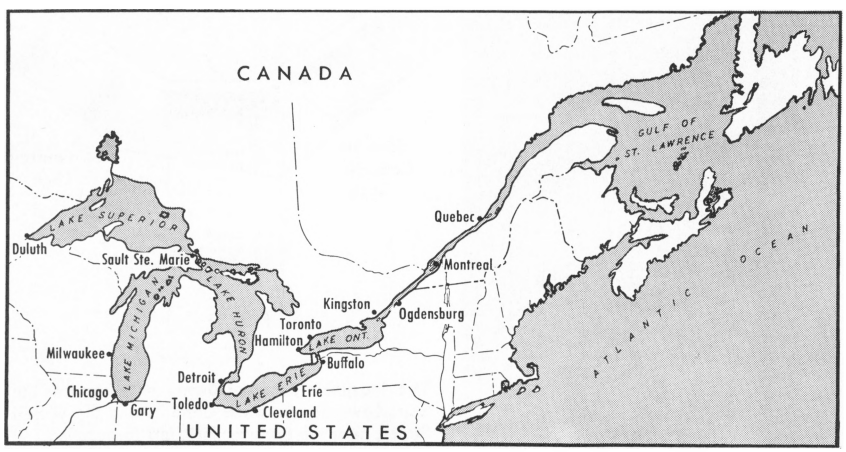
History

French explorer Jacques Cartier discovered the Saint Lawrence River in 1535. He hoped the river would open into the Northwest Passage to the Orient. However, he was stopped by the Lachine Rapids near the site of Montreal. French fur traders and missionaries built a shallow canal with a wooden lock around these rapids in 1700. The Canadians continued to build canals. By 1903, they had completed a navigable channel, 14 feet (4.3 meters) deep, from the Atlantic Ocean to Lake Erie. In 1823, the United States began to improve the channels between the Great Lakes. By 1914, the United States had provided channels 25 feet (7.6 meters) deep from Lake Superior to Lake Erie.

The improved channels were soon outmoded by the growth of shipping and the increased number of large ships. By the 1890's, many citizens of Canada and the United States were urging the cooperative development of the Saint Lawrence resources. The International Joint Commission was created in 1911, with authority over the boundary waters of the United States and Canada. In 1920, the two countries asked the commission to investigate the resources of the upper Saint Lawrence region. The commission, made up of three members from each country, issued a report in 1921. The members recommended that a joint power-and-navigation project be undertaken.

Treaty of 1932. A treaty was signed by representatives of the United States and Canada in 1932. It provided for the construction of a waterway, 27 feet (8.2 meters) deep, from the Atlantic Ocean to the head of Lake Superior. It also provided for development of hydroelectric power in the International Rapids section of the Saint Lawrence River. Power and costs were to be shared equally by the two nations.

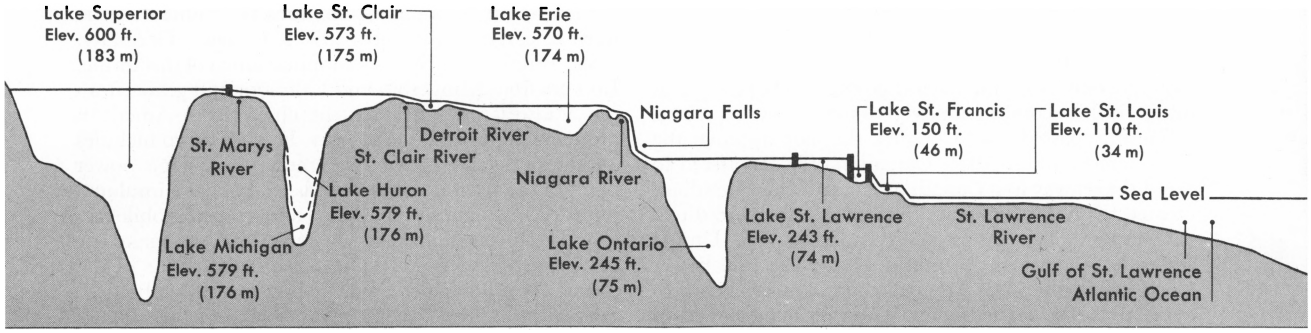
President Franklin D. Roosevelt urged the United States Senate to approve the measure. However, rail-



Inland Cities on the Saint Lawrence River system have become international ports since the development of the waterway. The seaway has opened the interior of the North American continent to ocean ships.

WATER LEVELS ON THE ST. LAWRENCE SYSTEM

This drawing shows how a ship sailing the St. Lawrence System moves from 600 feet (183 meters) above sea level in Lake Superior to sea level in the Gulf of St. Lawrence.

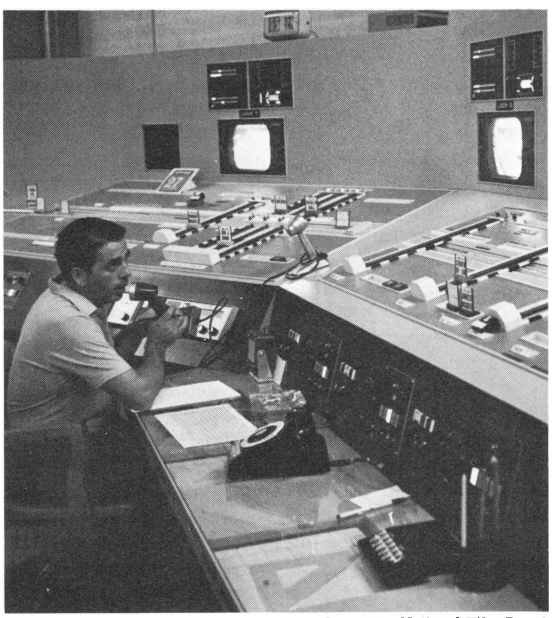


roads, shipping interests, and Eastern and Gulf ports opposed the proposal. Private utility companies and the coal-mining industry also feared the competition of Saint Lawrence power. In 1934, the United States Senate refused to ratify the treaty with Canada.

Agreement of 1941. World War II renewed interest in the seaway by creating a demand for electricity and shipbuilding resources. A new Canadian-United States understanding was signed in March, 1941. It included plans for the redevelopment of Niagara Falls, as well as the previous proposals for navigation and power development. It was subject to approval by a simple majority in both houses of the United States Congress. The House Committee on Rivers and Harbors supported the agreement. But the attack on Pearl Harbor in December, 1941, pushed the bill aside in favor of more urgent matters. An acute power shortage developed on both sides of the Canadian-United States boundary. In 1942, President Roosevelt considered using executive authority to start the power development. He decided not to when he learned that three years would be required to obtain electricity from the development.

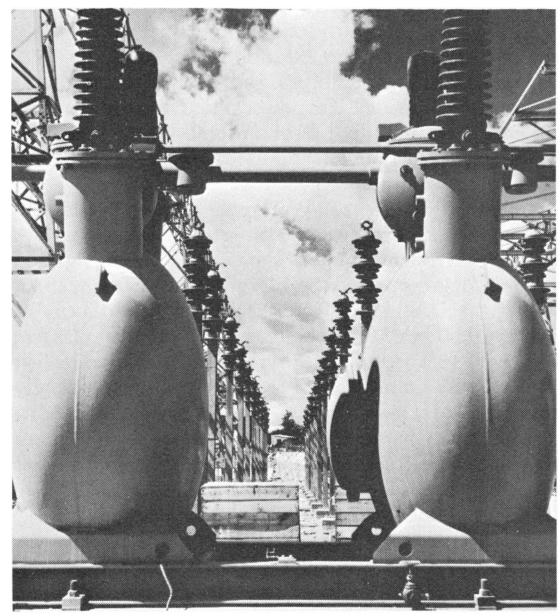
Early in 1948, officials of Ontario and of New York state tried to end the deadlock. They proposed a separation of the power and navigation projects. The separation would have enabled the province and state to proceed at once with the power project. The navigation project would have remained a joint federal undertaking.

The new procedure called for the approval of both federal governments. New York state had to secure a license from the Federal Power Commission. The approval of the International Joint Commission was necessary in order to change the level of the Saint Lawrence River. At first, President Harry S. Truman and key members of the Canadian Cabinet opposed the measure. They feared that the separation of the two projects would seriously delay the navigation improvements. For months, they refused to transmit the applica-



J. Reeves, National Film Board

The Control Room at the Welland Canal, which links Lakes Erie and Ontario, includes a panel of television monitors.



Wide World

Huge Circuit Breakers make up part of the Saint Lawrence Seaway power system, which serves U.S. and Canadian cities.

tions to the International Joint Commission. New York state also encountered difficulties in obtaining a license from the Federal Power Commission. Hearings extended over more than a two-year period. Finally, in 1950, the commissioners rejected the state's application. They recommended that the federal governments proceed at once with the combined navigation-and-power project.

Months passed and Congress did not approve the 1941 agreement. In 1951, Canadian officials offered to build the seaway as a Canadian project. The Canadians created the Saint Lawrence Seaway Authority to direct the undertaking. In return, they asked the United States to permit the Ontario Hydro-Electric Power Commission and some American company or agency to develop the power resources. The President agreed to support the Canadian action if an early start on the joint project could not be made.

In June, 1952, the two federal governments submitted applications to the International Joint Commission. They asked for the construction of power works in the International Rapids section by the Ontario Hydro-Electric Power Commission and a United States "entity." Three months later, the Federal Power Commission agreed to reconsider New York state's application for a license. The International Joint Commission speedily granted permission for the construction of the power development. However, 21 months passed before the U.S. government selected the cooperating "entity." The government finally chose the Power Authority of New York to direct the state's phase of the project.

The long delay placed a serious strain on United States-Canadian relations. It also gave the United States a final opportunity to obtain a share in the seaway. The Wiley-Dondero bill passed both houses of Congress in May, 1954. President Dwight D. Eisenhower signed the measure. The Wiley-Dondero Act created the Saint Lawrence Seaway Development Corporation. The act provided for a channel, 27 feet (8.2 meters) deep, from the Atlantic Ocean to Lake Erie. The navigation phase of the project was to be a joint federal undertaking. The power phase was to be undertaken by the province of Ontario and the state of New York. The Canadian government agreed to readmit the United States to the project.

Construction Begins. Workmen began blasting operations for the hydroelectric project in August, 1954. A month later, construction started on the navigation phase. Congress passed the Blatnik Act in March, 1956, giving the U.S. Army Corps of Engineers authority to deepen the Great Lakes connecting channels to 27 feet (8.2 meters). The hydroelectric project generated its first power in the summer of 1958. The seaway was officially opened to ocean shipping the following spring.

Improvements to the seaway are made in winter when ice floes force the seaway to close. Some major ports, such as Chicago, Detroit, and Montreal, have added dock facilities to handle the heavier traffic.

Results. The Saint Lawrence Seaway opened up the interior of North America to international shipping. On April 30, 1959, the *Prins Johan Willem Friso*, a Dutch ship, docked in the Chicago harbor. It was the first ocean-going ship to travel through the seaway to this great port of the St. Lawrence-Great Lakes water route. Ships carried about 20 million short tons (18 million metric tons) of cargo on the seaway in its first year of operation. This was twice the amount carried on the old St. Lawrence canals. Ships on the seaway carried about 54 million short tons (49 million metric tons) of cargo in the early 1970's. Canada, Germany, Great Britain, and Norway supplied much of this traffic. Iron ore from Minnesota and Labrador and grains from the Midwest have become the chief North American products shipped on the seaway. Foreign cargo includes automobiles and heavy machinery. The huge power plant in the International Rapids section has stimulated industry. Two aluminum plants and an automobile factory have been built near Massena, N.Y., to make use of the increased power. The three installations of the power plant have increased the power supply about 20 per cent.

WILLIAM R. WILLOUGHBY

Related Articles in WORLD BOOK include:

Great Lakes
Inland Waterway
Saint Lawrence River
Saint Lawrence Seaway Development Corporation
Soo Canals
Welland Ship Canal

SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION is an agency of the United States government. It was created in 1954 to construct the United States share of the Saint Lawrence Seaway. It also was given the job of deepening the Thousand Islands section of the Saint Lawrence River, so that larger ships could use it. The corporation operates and maintains the navigation works, in cooperation with the Saint Lawrence Seaway Authority of Canada.

The corporation is managed by an administrator and a five-man advisory board. These officials are appointed by the President of the United States, with the consent of the Senate. The corporation is a part of the Department of Transportation.

WILLIAM R. WILLOUGHBY

SAINT LAWRENCE UNIVERSITY is a private coeducational arts and sciences school in Canton, N.Y. The nondenominational university includes a theological school, which grants the Bachelor of Divinity degree. The university also offers an engineering program in cooperation with Columbia University School of Engineering, Massachusetts Institute of Technology, and Rensselaer Polytechnic Institute. The Frederick A. Moran Memorial Institute on Delinquency and Crime is held on campus each summer. The university was founded in 1856. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT LAZARUS, ORDER OF, was a religious order of the Roman Catholic Church founded in Jerusalem about 1150. Its purpose was to care for sick pilgrims, especially lepers. Branches were started in various parts of Europe, with the most important one in Boigny, France. The order was later merged into that of Our Lady of Mount Carmel.

FULTON J. SHEEN

SAINT LEGER, *LEHJ ur,* **BARRY** (1737-1789), a British soldier, fought against the Americans in the Revolutionary War. St. Leger's retreat to Canada after the Battle of Oriskany in 1777 was instrumental in upsetting the British campaign plan, and contributed to Burgoyne's surrender at Saratoga (see BURGOYNE, JOHN). St. Leger also fought in the French and Indian Wars.

W. B. WILLCOX

SAINT LEO COLLEGE. See UNIVERSITIES AND COLLEGES (table).

Jack Zehrt

The Gateway Arch rises 630 feet (192 meters) along the Mississippi River. The arch, designed by the architect Eero Saarinen, is part of the Jefferson National Expansion Memorial in St. Louis.

SAINT LOUIS, *saynt LOO ihs,* is the largest city in Missouri and a leading industrial and transportation center of the United States. It lies on the west bank of the Mississippi River, about 10 miles (16 kilometers) south of where the Mississippi meets the Missouri River. This location has made St. Louis the busiest inland port on the Mississippi River.

In 1764, French fur traders built a post on the site of what is now St. Louis. They chose the site because Indians bringing furs to trade could reach it easily by canoe. The French named the settlement for King Louis IX, who had been made a saint. It came under U.S. control when President Thomas Jefferson bought the Louisiana Territory from France in 1803 (see LOUISIANA PURCHASE).

During the first half of the 1800's, St. Louis served as a gateway to the West and as a main port for Mississippi River steamboats. The city became a railroad center after the Civil War (1861-1865). During the late 1800's, industrial expansion helped St. Louis become one of the nation's chief urban centers.

Metropolitan St. Louis

St. Louis covers 61 square miles (158 square kilometers). The city's metropolitan area, which extends across the Mississippi River into Illinois, occupies 5,091 square miles (13,186 square kilometers). In Missouri, the metropolitan area includes Franklin, Jefferson, St. Charles, and St. Louis counties. In Illinois, it covers Clinton, Madison, Monroe, and St. Clair counties.

The City extends along the Mississippi River for 19 miles (31 kilometers). The Jefferson National Expansion Memorial stands on the riverfront. This memorial honors Thomas Jefferson, the Louisiana Purchase, and the pioneers who settled the West. It includes the Gateway Arch, 630 feet (192 meters) high, the nation's tallest monument. Small cars inside the monument carry visitors to the top of the arch, which offers a magnificent view of the city.

The historic riverfront area includes the Old Courthouse, site of the famous Dred Scott slavery trial (see DRED SCOTT DECISION). Also in the area are the Old Cathedral, a Roman Catholic church completed in 1834; and the *Goldenrod,* a historic showboat that presents oldtime dramas.

FACTS IN BRIEF

Population: 622,236; metropolitan area, 2,410,492 (1,827,236 in Missouri; 583,256 in Illinois).

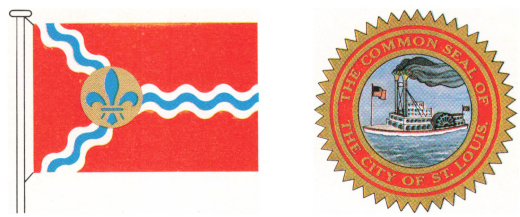
Area: 61 sq. mi. (158 km²). *Metropolitan Area*—5,091 sq. mi. (13,186 km²); 2,781 sq. mi. (7,203 km²) in Missouri, 2,310 sq. mi. (5,983 km²) in Illinois.

Altitude: 455 ft. (139 m) above sea level.

Climate: *Average Temperature*—January, 33° F. (1° C); July, 81° F. (27° C). *Average Annual Precipitation* (rainfall, melted snow, and other forms of moisture)—35 in. (89 cm). For the monthly weather, see MISSOURI (Climate).

Government: Mayor-council. *Terms*—4 years.

Founded: 1764. Incorporated as a town, 1809; as a city, 1822.



Symbols of St. Louis. The two wavy bars on the flag represent the Mississippi and Missouri rivers, and the fleur-de-lis in the disk stands for the French background of St. Louis. The steamboat on the city seal, *right,* symbolizes the city's early growth.

SAINT LOUIS

Downtown St. Louis lies between the riverfront and 15th Street. Many of the city's civic buildings rise around Memorial Plaza. They include the U.S. Courthouse, City Hall, the Municipal Courts Building, and Kiel Municipal Auditorium.

The residential areas of St. Louis spread outward from the downtown area. About two-thirds of the dwellings are single-family homes. Like many other industrial cities, St. Louis has large slums that contrast sharply with its suburbs.

The Metropolitan Area. St. Louis suburbs in Missouri include Clayton, Florissant, Kirkwood, Ladue, and Webster Groves. Several bridges across the Mississippi link St. Louis with the Illinois part of its metropolitan area.

The historic Eads Bridge extends from the foot of Washington Avenue to East St. Louis, the largest Illinois suburb of St. Louis. This bridge was considered an engineering wonder when it was completed in 1874. See EADS BRIDGE.

People

More than 95 per cent of the people of St. Louis were born in the United States. Many persons of German ancestry live on the city's South Side. Other groups in St. Louis include those of English, French, Italian, Scottish, or Spanish descent.

Negroes make up more than 40 per cent of the city's population. Almost all the blacks live in an area that extends from downtown to the northwestern border of St. Louis. This section includes the city's worst slums. Since the 1950's, public housing projects have replaced hundreds of run-down structures. But in spite of new public housing and other redevelopment programs, living conditions in the black community remain a major problem.

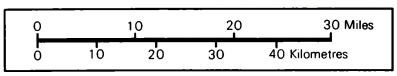
Racial tension is another chief concern in St. Louis, though the city has had much less racial violence than

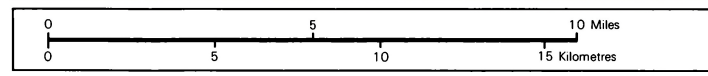
CITY OF ST. LOUIS

St. Louis lies in eastern Missouri below the junction of the Mississippi and Missouri rivers. The map at the right shows the city and its major points of interest. The map below shows the Greater St. Louis Area which includes some Illinois communities.

City boundary
County boundary
State boundary
Built-up area
Park
Airport
Main road
Other road
Rail line
Point of interest

Greater St. Louis Area





WORLD BOOK map

many other large urban centers. This situation has resulted partly from the strong stand for integration taken by the Roman Catholic Church in St. Louis. Besides Catholics, large religious denominations in St. Louis include Baptists, Lutherans, Methodists, Presbyterians, and members of the United Church of Christ.

Economy

Industry. The more than 3,000 manufacturing plants in metropolitan St. Louis produce over $5 billion worth of goods yearly. Approximately a third of the area's workers are employed in industry. The production of transportation equipment is the leading manufacturing activity, and St. Louis ranks high in automobile production. St. Louis plants also make airplanes, barges, railroad cars, and towboats. The city is the home of the Anheuser-Busch Company, the nation's largest beer producer. St. Louis also is an important manufacturer of automobile parts, chemicals, food and food products, and such primary metals as iron, lead, and zinc. The stockyards in East St. Louis, Ill., are among the top U.S. hog-shipping centers.

During the 1950's and 1960's, a number of industries moved from St. Louis to the suburbs. Today, many former manufacturing plants stand empty. The city is trying to attract new industry by offering reduced taxes.

Transportation. St. Louis ranks second only to Chicago among the leading U.S. rail and trucking centers. Railroad passenger trains, 17 rail freight lines, and about 300 trucking companies serve St. Louis. Several interstate highways connect in the city. Lambert-St. Louis Municipal Airport is one of the nation's busiest airports.

Public transportation is a serious problem in St. Louis. The Bi-State Development Agency, created by the legislatures of Missouri and Illinois, operates a bus system that serves the city and suburbs. But the system has difficulty providing adequate service and meeting costs. The city has no rapid-transit transportation.

St. Louis lies in the heart of the U.S. inland waterway system. The city handles more than 10 million short tons (9.1 million metric tons) of cargo yearly and ranks as a main port for barges that travel the Mississippi River. About 25 barge lines serve the city.

Finance. St. Louis is the financial center of the Central Mississippi River Valley. It serves as the headquarters of the Eighth Federal Reserve District Bank. The city also has a Federal Land Bank, which provides long-term loans to farmers. St. Louis is the only U.S. city with both types of federal banks.

Communication. The leading daily newspapers in St. Louis are the morning *Globe-Democrat* and the afternoon *Post-Dispatch*. More than 20 radio stations and 6 television stations serve the city.

Education

The St. Louis public school system includes about 150 elementary schools and 13 high schools, with a total of more than 110,000 students. Negroes make up approximately 65 per cent of the public school enrollment. The overcrowding of schools in chiefly black areas is a major problem in St. Louis. To ease the situation, many Negro students are bused to less crowded schools. About 25,000 students attend the city's more than 70 Roman Catholic schools. St. Louis also has about 15 Lutheran schools and 15 other private schools.

Courtesy Missouri State Highway Commission

Automobile Manufacturing is a chief industry in St. Louis. Only Detroit and Flint, Mich., make more cars than St. Louis.

St. Louis University, founded in 1818, is the oldest university west of the Mississippi River. Other schools in or near St. Louis include Cardinal Glennon College, Fontbonne College, Harris Teachers College, Maryville College of the Sacred Heart, St. Louis College of Pharmacy, Washington University, Webster College, and a branch of the University of Missouri.

The main St. Louis Public Library owns more than a million books. It has 20 branches.

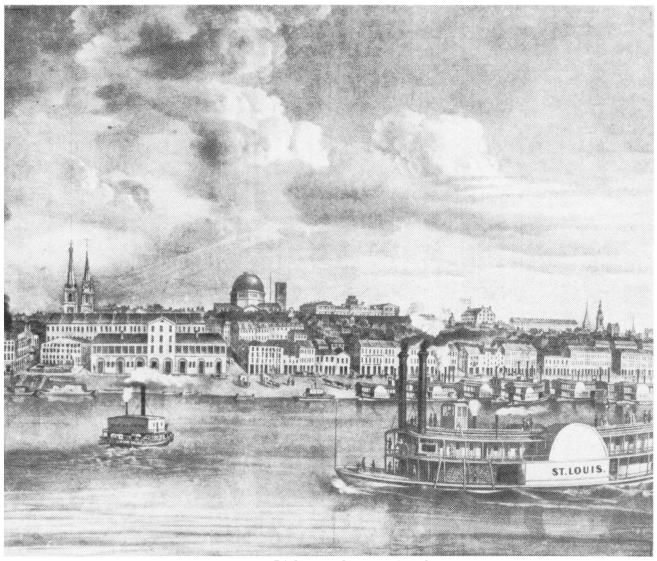
Cultural Life

The Arts. The St. Louis Symphony Orchestra, the second oldest orchestra in the United States, performs in Powell Hall. It began as a choral group in 1880, about 40 years after the New York Philharmonic Orchestra was established. Every summer, the St. Louis Municipal Opera presents light opera and musical comedy in the 11,000-seat Municipal Open-Air Theater. Other musical groups include the St. Louis Little Symphony and the St. Louis Philharmonic. The City Art Museum of St. Louis is famous for its Oriental art. The American Theatre presents major stage attractions.

Museums. The Museum of Westward Expansion, beneath the Gateway Arch, features exhibits on the history of the West. The Jefferson Memorial Building displays trophies of Charles A. Lindbergh, who in 1927 made the first solo flight across the Atlantic Ocean. In the building, a museum operated by the Missouri Historical Society has exhibits on the fur trade and the Lewis and Clark expedition to the Northwest. The National Museum of Transport, in Kirkwood, has old locomotives, streetcars, buses, and horse-drawn equipment.

Recreation

Parks. St. Louis has about 70 parks. Forest Park, covering 1,374 acres (556 hectares), is one of the largest



Lithograph (late 1840's) by Julius Hutawa; Missouri Historical Society, St. Louis

The St. Louis Riverfront served as a main port for steamboats that traveled on the Mississippi River during the mid-1800's.

city parks in the United States. It includes golf courses, lagoons for boating, and picnic areas. The park is the site of the St. Louis Zoo, noted for its animal shows; the Jewel Box, a building that features flower exhibits; and the McDonnell Planetarium.

The Missouri Botanical Garden, near Tower Grove Park, has one of the nation's finest collections of plant life. Its more than 12,000 kinds of plants come from all parts of the world. The garden includes the Climatron, a modern greenhouse that grows tropical plants.

Sports. St. Louis has two professional athletic teams called the Cardinals. The baseball club competes in the National League, and the football team is a member of the National Football League. Both play in Busch Memorial Stadium. The St. Louis Blues of the National Hockey League play in the St. Louis Arena. The Spirits of St. Louis of the American Basketball Association also play there.

Other Interesting Places to Visit include:

Aloe Plaza, on Market Street. It features the *Meeting of the Waters* fountain designed by the sculptor Carl Milles. The fountain portrays the meeting of the Mississippi and Missouri rivers.

Grant's Farm, in Grantwood. This 281-acre (114-hectare) area includes a cabin owned by Ulysses S. Grant before the Civil War. Buffalo, deer, and elk roam through a nearby park.

Government

St. Louis has a mayor-council form of government. The voters elect the mayor, the 28 members of the Board of Aldermen, and the president of the Board of Aldermen—all to four-year terms. The city's chief sources of income are taxes on property and on individual and business earnings. The earnings tax is collected from everyone who lives or works in St. Louis.

Unlike most cities, St. Louis does not control its own police department or its department of elections. These departments are run by commissions that consist chiefly of members appointed by Missouri's governor.

St. Louis is also one of the few U.S. cities that is not in a county. In 1876, St. Louis withdrew from St. Louis County and became an independent city. It took this action so it could elect officials who would take a special interest in St. Louis affairs. The city has the status of a county—though it is not officially one—so it can be represented in the Missouri legislature. St. Louis County surrounds the city in Missouri. St. Louis has often tried to extend its borders, but the county has opposed such changes. The county has also blocked (1) all the city's efforts to rejoin the county and (2) nearly all its proposals to form joint agencies to handle metropolitan problems.

History

Early Settlement. The Missouri and Osage Indians lived in the St. Louis region when French explorers arrived in the mid-1600's. In 1763, a French fur trader, Pierre Laclède Liguest, and his 14-year-old stepson, René Auguste Chouteau, visited the site of what is now St. Louis. The next year, they established a settlement there and opened a trading post. See CHOUTEAU.

The community was actually founded on Spanish territory. In a secret treaty signed in 1762, France had given all its territory west of the Mississippi River to Spain. The French gave their land east of the river to Great Britain in 1763. St. Louis grew rapidly as French settlers, who preferred Spanish to British rule, crossed the river and settled around the trading post.

The 1800's. France regained control of the St. Louis region in 1800, under another treaty. On March 10, 1804, the transfer of the northern part of the Louisiana Purchase region from France to the United States took place in St. Louis. The settlement soon became a key point in the westward expansion of the United States. The expeditions of Meriwether Lewis and William Clark and of Zebulon M. Pike started from the St. Louis area. Keelboats, and later steamboats, traveled up the Missouri River and its tributaries and returned with fortunes in furs.

St. Louis was incorporated as a town in 1809. In 1822, when it became a city, St. Louis had a population of about 5,000. During the mid-1800's, large numbers of German and Irish workers settled in the city. Between 1840 and 1860, the population of St. Louis increased from 16,469 to 160,773.

During the Civil War, St. Louis served as the western headquarters of the Union Army. Railroad construction and the expanding trade of the Southwest brought steady growth to the city after the war. By 1870, St. Louis had 310,864 persons and was the nation's third largest city behind New York City and Philadelphia.

In 1874, the Eads Bridge was completed across the Mississippi River. The Illinois coal fields then became easier to reach from St. Louis, and the city's suburbs in that state began to grow. In 1876, St. Louis withdrew from St. Louis County. The city became an important manufacturing center during the late 1800's.

The 1900's. The Louisiana Purchase Exposition was held in Forest Park in 1904, along with the Olympic Games. The exposition, also called the St. Louis World's Fair, boosted trade and culture in the city. See LOUISIANA PURCHASE EXPOSITION.

St. Louis continued to grow during the early 1900's. By 1920, its population reached 772,897. Bond issues totaling more than $100 million were passed during the 1920's and 1930's. They helped pay for street widening and new public buildings. In 1927, a group of St. Louis businessmen financed Charles A. Lindbergh's historic flight from the United States to France. Lindbergh's airplane was named *Spirit of St. Louis*. See LINDBERGH, CHARLES AUGUSTUS.

During World War II (1939-1945), St. Louis factories produced military equipment for the Allies. By 1950, 856,796 persons lived in the city.

Recent Developments. A nationwide trend toward suburban living, which began during the 1950's, has resulted in thousands of white St. Louisans moving to newly built areas outside the city. The population of St. Louis fell to 750,026 by 1960 and dropped to 622,-236 by 1970.

Problems of citywide decay became increasingly serious during the 1950's. In 1955, St. Louis voters approved three bond issues totaling more than $165 million. These funds were used to build schools, expressways, and other public projects. During the 1960's, the city redeveloped Mill Creek Valley, a 465-acre (188-hectare) slum area in the heart of St. Louis. This project included construction of commercial buildings, a retirement center, a new campus for St. Louis University, and middle-income housing. The city's development plans for the 1970's included construction of a second major airport. SAM J. SHELTON, JR.

See also MISSOURI (pictures).

SAINT LOUIS COLLEGE OF PHARMACY. See UNIVERSITIES AND COLLEGES (table).

SAINT LOUIS UNIVERSITY is a private, coeducational school in St. Louis, Mo. It is sponsored by the Society of Jesus, and governed by a board of trustees composed of Jesuits and laymen. Divisions of St. Louis University include the schools of arts and sciences, commerce and finance, engineering, aeronautical engineering, philosophy and letters, nursing and health services, law, medicine, social service, divinity, and the graduate school. Its medical and nursing schools, and hospitals and clinics make up the world's largest Catholic medical center. The school's Pius XII Memorial Library contains on microfilm the general collection, and 12 million pages of manuscript from the Vatican Library. Founded in 1818, the school is the oldest university west of the Mississippi River. For enrollment, see UNIVERSITIES AND COLLEGES (table). PAUL C. REINERT

SAINT LUCIA. See WEST INDIES ASSOCIATED STATES.

SAINT LUCIA DAY. See CHRISTMAS (In Sweden).

SAINT MARK, CATHEDRAL OF, is a famous Roman Catholic church in Venice, Italy. It is named for St. Mark the Evangelist, the patron saint of Venice. The cathedral used to be the private chapel of the Doge, the ruler of Venice. It is now the cathedral of the city. The Cathedral of Saint Mark is one of the finest examples of Byzantine architecture in Western Europe (see VENICE [picture]).

The building is in the form of a Greek cross, 250 feet (76 meters) long and 220 feet (67 meters) wide at the widest point. A dome, 42 feet (13 meters) in diameter, rises over the center of the church, and smaller domes rise over each arm. The inside of the cathedral is entirely covered with mosaics. Marbles, carvings, and the famous *Pala d'Oro*, or Altar of Gold, also add to the interior beauty of the cathedral. Four bronze horses, brought from Constantinople (now Istanbul) in 1204, stand over the center door. A *campanile* (bell tower) stands in Saint Mark's Square (see CAMPANILE).

Gendreau

The Cathedral of Saint Mark in Venice, Italy, is an outstanding example of Byzantine architecture. The church is decorated with beautiful carvings, mosaics, and religious statues.

When St. Mark's was built, beginning about A.D. 1050, Venice maintained close trade relations with the East. By law, every merchant who traveled to the Orient had to bring back some object for the church. This built an art collection. OTTO G. VON SIMSON

SAINT MARTIN'S COLLEGE is a coeducational Roman Catholic school in Olympia, Wash. Courses lead to B.A. and B.S. degrees in liberal arts, business administration, and civil engineering. Saint Martin's College was founded in 1895. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT MARTIN'S SUMMER. See INDIAN SUMMER.

SAINT MARY, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

SAINT MARY COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT MARY OF THE PLAINS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT MARY-OF-THE-WOODS COLLEGE is a women's school in St. Mary-of-the-Woods, Ind. It is conducted by the Sisters of Providence of the Roman Catholic Church. Courses are offered in the liberal arts, fine arts, and sciences. The school was founded in 1840. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT MARYS CITY. See MARYLAND (Places to Visit).

SAINT MARY'S COLLEGE is a coeducational liberal arts school in Winona, Minn. It is controlled by the Brothers of the Christian Schools, a Roman Catholic lay organization. Courses are offered leading to A.B. and B.S. degrees. St. Mary's was founded in 1912. For the enrollment of St. Mary's College, see UNIVERSITIES AND COLLEGES (table).

SAINT MARY'S COLLEGE is a Roman Catholic liberal arts school for women at Notre Dame, Ind. Courses lead to B.A., B.S., and B.M. degrees. Saint Mary's College was founded in 1844. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT MARY'S COLLEGE OF CALIFORNIA in the town of St. Mary's College is a coeducational Roman Catholic school. Courses are offered in liberal arts, economics, prelaw, business administration, premedicine, and predentistry. It was founded in 1863. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT MARY'S COLLEGE OF MARYLAND. See UNIVERSITIES AND COLLEGES (table).

SAINT MARY'S DOMINICAN COLLEGE is a Roman Catholic liberal arts school for women at New Orleans, La. It is under the direction of the Dominican Sisters. Upon graduation, students receive either an A.B. or B.S. degree. St. Mary's was founded in 1910. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT MARYS RIVER is the stream that carries the waters of Lake Superior into Lake Huron. It is about 40 miles (64 kilometers) long, and forms part of the boundary between Ontario and Upper Michigan. Islands divide the river into two main channels, and each channel spreads out into several lakelike bays. The Saint Marys Rapids are near the northern end of the river. Here there is a fall of nearly 20 feet (6 meters) within 1 mile (1.6 kilometers). The Soo (Sault Sainte Marie) canals and locks have been built so ships can by-pass the rapids.

The rapids furnish power for industry. A railroad bridge crosses the rapids. The 2-mile (3.2-kilometer) International Bridge carries traffic across the Saint Marys River at Sault Ste. Marie. WILLIS F. DUNBAR

SAINT MARY'S SEMINARY AND UNIVERSITY is a Roman Catholic school for men in Baltimore, Md. It trains men for the priesthood. Founded in 1791, St. Mary's is the oldest Catholic seminary in the United States. For enrollment, see UNIVERSITIES AND COLLEGES (table). CORNELIUS M. CUYLER

SAINT MARY'S SEMINARY COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT MARY'S UNIVERSITY is located at Halifax, N.S. It is conducted by the Roman Catholic Jesuit Fathers of Upper Canada. It grants bachelor's degrees in commerce, education, engineering, liberal arts, and science, and grants master's degrees in education and philosophy. It was founded in 1841. For enrollment, see CANADA (table: Universities and Colleges). C. J. FISCHER

SAINT MARY'S UNIVERSITY is a coeducational school in San Antonio, Tex. It is affiliated with the Roman Catholic Church. The university has a school of arts and sciences, a business school, and a law school. It grants bachelor's and master's degrees. The school was founded in 1852. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT MAURICE RIVER. See SAINT LAWRENCE RIVER (Sources); QUEBEC (color pictures).

SAINT MEINRAD COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT MICHAEL, FEAST OF. See MICHAEL, SAINT.

SAINT MICHAEL'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT MIHIEL. See WORLD WAR I (The Last Campaigns).

SAINT MORITZ, *saynt moh RITZ* (pop. 3,751), is a famous resort town in Switzerland. It lies at 6,037 feet (1,840 meters) above sea level, in the Engadine, the upper part of the great Inn River Valley. For location, see SWITZERLAND (color map). St. Moritz is one of the highest villages in the valley, and has a magnificent view. Visitors come to St. Moritz from all parts of the world. Its baths have been famous since the 1500's. St. Moritz is one of the most popular ski resorts in Europe. FRANKLIN CARL ERICKSON

SAINT NICHOLAS, FEAST OF, falls on December 6. People in many European countries celebrate it as a special holiday. In some places, children believe that Saint Nicholas appears on the eve of his feast day with gifts for good boys and girls. Dutch settlers brought the customs of celebrating his feast day to America. The Feast of Saint Nicholas gradually became part of the American tradition of Christmas. See also CHRISTMAS; NICHOLAS, SAINT; SANTA CLAUS.

SAINT NORBERT COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT OLAF COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT PATRICK'S CATHEDRAL is a famous Roman Catholic church on Fifth Avenue in New York City. It is the seat of the Archdiocese of New York. St. Patrick's was the first major cathedral built in the neo-Gothic style in the United States. The cornerstone was laid in 1858 and the building opened in 1879. The cathedral resembles several French and English Gothic churches, including the church at St. Ouen in Rouen, France. Much of the decoration in the cathedral is of European workmanship. G. HOLMES PERKINS

See also NEW YORK CITY (picture).

SAINT PATRICK'S COLLEGE is a coeducational Roman Catholic college in Ottawa, Ont. St. Patrick's offers courses in business administration, the liberal arts, and the social sciences which lead to bachelor's and master's degrees. The school is operated by the Congregation of the Oblates of Mary Immaculate. It was founded in 1929.

SAINT PATRICK'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT PATRICK'S CROSS. See FLAG (pictures: Historical Flags of the World [Crosses in the British Flag]).

SAINT PATRICK'S DAY is celebrated on March 17 in honor of the patron saint of Ireland. Many legends have grown up about St. Patrick. One of them is that he used the shamrock to illustrate the idea of the Trinity.

His death on March 17, in about 461, has been observed in America since colonial days. The Friendly Sons of St. Patrick was organized in Philadelphia. In New York, Irishmen of the Roman Catholic and Presbyterian faiths organized another chapter of the society. Observance of the day since 1845 has become nationwide. It is celebrated in homes, churches, schools, and places of entertainment. Merchants sell special wearing apparel, flowers, shamrocks, and greeting cards. Some cities hold St. Patrick's Day parades. RAYMOND HOYT JAHN

See also PATRICK, SAINT; SHAMROCK.

SAINT PATRICK'S SEMINARY. See UNIVERSITIES AND COLLEGES (table).

SAINT PAUL, Minn. (pop. 309,714), is the capital and second largest city of the state. Only Minneapolis, St. Paul's "twin city," is larger. The metropolitan area of the two cities has a population of 1,965,391. St. Paul lies in southeastern Minnesota, about 400 miles (640 kilometers) northwest of Chicago. For location, see MINNESOTA (political map). The city serves as the distribution and transportation center for a rich Midwestern farm area.

In 1840, several families and a French-Canadian trader named Pierre Parrant founded a settlement that grew into St. Paul. The settlement was first known as Pig's Eye, which was Parrant's nickname. It became St. Paul after the construction in 1841 of a church dedicated to that saint.

The City. St. Paul covers about 55 square miles (142 square kilometers), including 3 square miles (8 square kilometers) of inland water. It is the seat of Ramsey County. The city lies on both banks of the Mississippi River, but most of it is on three terraces on the north bank. The lowest terrace consists of factories and railroad yards. The business district of St. Paul stands on the middle terrace, and homes occupy the highest one.

The State Capitol is at the north end of Wabasha Street in downtown St. Paul. South on Wabasha, on the north bank of the river, stands the City Hall and County Courthouse. The Cathedral of St. Paul, a St. Paul landmark, is on Summit Avenue.

About 95 per cent of St. Paul's people were born in the United States. The city's population includes groups of German, Irish, Polish, and Scandinavian descent. American Indians, Mexican Americans, and Negroes make up less than 10 per cent of the population. Lutherans form the largest religious group in the city, followed by Roman Catholics and Methodists.

Economy. St. Paul ranks as an important distribution and transportation center. Retail and wholesale warehouses operate in the city and its suburbs. More than 100 trucking lines serve the Twin Cities area.

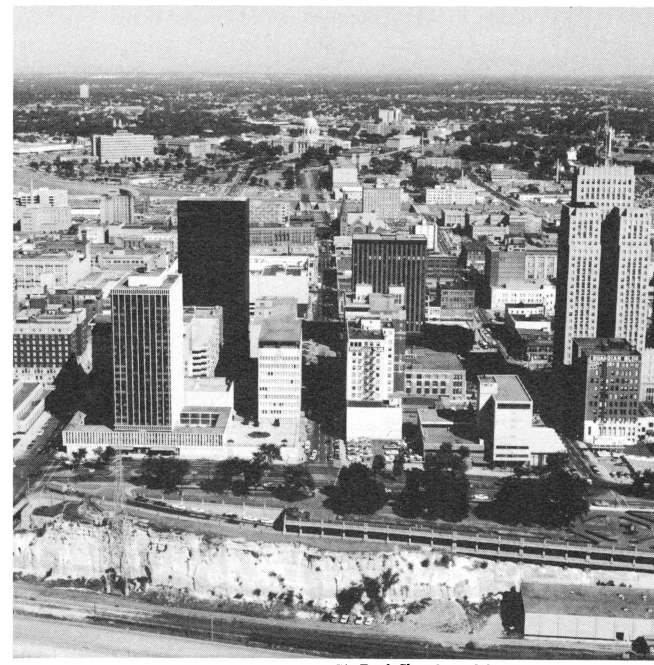
Five railroads provide St. Paul with freight service. Passenger trains use a terminal in Minneapolis. Eight airlines serve St. Paul. The St. Paul Downtown Airport lies south of the Mississippi River, and the Minneapolis-St. Paul International Airport is southwest of the city. Barges on the Mississippi carry more than 5 million short tons (4.5 million metric tons) of goods to and from St. Paul annually.

About 500 factories in St. Paul employ about a third of the city's workers. Nonelectrical machinery is the chief product. Other products include automobiles, cosmetics, electrical machinery, fabricated metals, wood products, plastics, and transportation equipment.

Education and Cultural Life. St. Paul's public school system includes 70 elementary and junior high schools and 9 high schools. The city also has about 50 parochial and private schools.

Colleges and universities in St. Paul include Bethel College, the College of St. Catherine, Concordia College, Hamline University, and Macalester College.

Two daily newspapers, the *Dispatch* and the *Pioneer Press*, serve the city. The *Pioneer Press*, Minnesota's oldest newspaper, was founded in 1849 as the *Minnesota Pioneer*. St. Paul has 6 television stations and about 30 radio stations. The St. Paul Public Library operates 10 branches and 1 bookmobile. The St. Paul Council of Arts and Sciences administers the Minnesota Museum of Art, the Philharmonic Society, The Science Museum, and the St. Paul Opera Association.



St. Paul Chamber of Commerce

St. Paul is Minnesota's capital and second largest city. The State Capitol, *rear,* stands at the edge of downtown St. Paul.

St. Paul's park system includes more than 50 major recreation sites and covers over 2,000 acres (810 hectares). The St. Paul area has more than 30 lakes. Major annual attractions in St. Paul include the Winter Carnival in January and February and the Minnesota State Fair, held from late August through Labor Day.

Three professional sports teams play at facilities in Bloomington, a suburb of the Twin Cities. The Minnesota Twins baseball team of the American League and the Minnesota Vikings of the National Football League play in Metropolitan Stadium. The Minnesota North Stars of the National Hockey League play in the Metropolitan Sports Center. A fourth team, the Minnesota Fighting Saints of the World Hockey Association, plays in the St. Paul Civic Center.

Government. St. Paul has a mayor-council form of government. The voters elect a mayor and seven city council members, all to two-year terms. St. Paul gets most of its income from property taxes.

History. Sioux Indians lived in what is now the St. Paul area long before white men arrived. During the early 1820's, the U.S. Army built Fort St. Anthony there. The fort covered a large area on the west side of the Mississippi River and soon attracted settlers. It was renamed Fort Snelling in 1825. In 1840, several families and a French-Canadian trader, Pierre Parrant, left the military property. They moved farther east and

founded the settlement that became St. Paul. In 1841, Lucian Galtier, a Roman Catholic priest, built St. Paul's Chapel there. Steamboats began to stop at the settlement. St. Paul soon became an important fur-trading post and a busy river port.

In 1849, St. Paul was incorporated as a town and became capital of the Minnesota Territory. About 840 persons lived in the town at that time. The settlement that became Minneapolis was established in 1849. During the mid-1800's, St. Paul was the leading commercial center of the Northwest.

St. Paul received its city charter in 1854. It had a population of 10,401 by 1860. During this period, the rich farmlands around St. Paul and jobs in the nearby forests and iron ore mines attracted thousands of European immigrants. The railroad financier James J. Hill helped the civic, cultural, and industrial development of St. Paul in the late 1800's. For example, he donated funds to build a library and the Cathedral of St. Paul. By 1893, Hill had extended the Great Northern Railway from St. Paul to Puget Sound in the state of Washington (see HILL, JAMES JEROME). Also at this time, Archbishop John Ireland became a civic and religious leader in St. Paul. He helped establish immigrants and other settlers in the area.

St. Paul prospered through trade and transportation. Large flour mills helped Minneapolis grow. By 1880, Minneapolis had a population of 46,887, compared with St. Paul's 41,473. Minneapolis continued to grow faster than St. Paul because of greater industrial development. The population of St. Paul rose from 133,156 in 1890 to 214,744 in 1910.

The city's economy slumped during the 1920's and the Great Depression of the 1930's. By 1940, downtown St. Paul had become old and shabby. In the 1950's, city leaders began to plan urban renewal projects.

From 1964 to 1972, St. Paul completed about $200 million worth of urban renewal construction in the downtown area. Capital Centre, one of the renewal projects, covers 12 blocks and features new apartment and office buildings and stores. These buildings are linked by enclosed pedestrian bridges over the streets. St. Paul's $19½-million Civic Center, completed in 1973, has a circular arena with a seating capacity of 19,000.

In spite of its progress, St. Paul still has many problems. Major challenges include finding better ways to control air and water pollution and to rebuild run-down neighborhoods. The city is also working to improve educational opportunities for Negroes and other minority groups.

JOHN R. FINNEGAN

For the monthly weather in Minneapolis-St. Paul, see MINNESOTA (Climate). See also MINNESOTA (pictures).

SAINT PAUL ISLAND. See PRIBILOF ISLANDS.

SAINT PAUL SEMINARY. See UNIVERSITIES AND COLLEGES (table).

SAINT PAUL'S CATHEDRAL. See LONDON (Churches).

SAINT PAUL'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT PETER'S CHURCH, in Vatican City, is the largest Christian church in the world. Also called SAINT PETER'S BASILICA, it is the second church to stand above the *crypt* (tomb) which is believed to contain the body of Saint Peter, the first pope.

Saint Peter's is built in the shape of a cross. The church is almost 700 feet (210 meters) long and about 450 feet (137 meters) across at its widest point. It covers about 15,500 square yards (12,960 square meters). The *nave* (center aisle) is 150 feet (46 meters) high. The building's most outstanding architectural feature is its magnificent dome, designed by Michelangelo. The dome rises more than 400 feet (120 meters) from the floor of the church, and measures 138 feet (42 meters) in diameter.

Forum, Black Star

Saint Peter's Church in Vatican City stands over the tomb believed to contain Saint Peter's body. Only the pope or a cardinal representing him is permitted to celebrate Mass at the high altar in Saint Peter's. The altar is in the center of the church, under a bronze canopy. The church can hold over 50,000 persons.

The Exterior. The church was given an impressive setting by Gian Lorenzo Bernini, one of its architects. From a great distance, the church appears to be set on a stage. An avenue 1 mile (1.6 kilometers) long leads from the Tiber River to the *Piazza di San Pietro* (Square of Saint Peter), a large open space in front of the church. Double colonnades are arranged in semicircles on two sides of the piazza.

A red granite *obelisk* (shaft) stands 85 feet (26 meters) high in the piazza's center. It was brought to Rome from Egypt about A.D. 37, and was moved to the piazza in 1586.

The Interior of the church is decorated in baroque style. Its most famous features are the work of Bernini, who was also a sculptor. He built the elaborate bronze *baldacchino* (canopy) over the main altar, which stands beneath the dome. Marble, gilding, and mosaics decorate the walls and ceiling of the church. Chapels, altars, and tombs line the walls. Michelangelo's famous sculpture, the *Pietà*, stands in one of the chapels.

History. The first Saint Peter's, called the Basilica of Constantine, was begun by Constantine the Great about 325. He built the church to symbolize his acceptance of Christianity.

The church was modeled on the *basilica*, a rectangular building used as a meeting hall by the Romans (see BASILICA). Four rows of columns, extending almost the length of the church, divided it into a nave with two aisles on either side. Throughout the Middle Ages, many persons made pilgrimages to the church, and many great medieval churches were copied from its design. In 1506, Pope Julius II decided to rebuild the church completely. He demolished the original church, and only the tomb and a few small details of this church remain.

Rebuilding Saint Peter's took almost 150 years. During this time, 10 different architects worked on the church and changed its design. The first architect was Donato Bramante. He designed a domed, perfectly symmetrical church in the form of a *Greek cross* (a cross with four arms of equal length). But the nave was lengthened in the 1600's, so that the church took the form of a Latin cross. Only the gigantic scale and dimensions of Bramante's work remain.

The most important architects were Michelangelo and Bernini. Michelangelo became the church's architect in the 1540's, when he was over 70 years old. He changed Bramante's plan for a balanced and restful dome into a dynamic construction. Michelangelo put a *drum* (ring) at the base of the dome that appears to be squeezing the dome and forcing its sides to spring upwards.

Bernini began his work on Saint Peter's in 1623. The building was dedicated in 1626 by Pope Urban VIII, but other parts were added later. JOACHIM SMET

Related Articles in WORLD BOOK include:
Architecture (Renaissance [picture])
Bernini, Gian Lorenzo
Bramante, Donato
Dome (picture)
Italy (Arts [picture])
Michelangelo
Pope (picture)
Rome (Churches, Palaces, and Fountains)
Vatican City

SAINT PETER'S COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT PETERSBURG. See LENINGRAD.

SAINT PETERSBURG, Fla. (pop. 216,159), is a popular resort city and retirement center. It lies on Tampa Bay at the tip of Pinellas Peninsula. For location, see FLORIDA (political map). St. Petersburg is sometimes called the *Sunshine City* because of its pleasant climate. A St. Petersburg newspaper, the *Evening Independent*, is distributed free if the sun did not shine the previous day. The paper is given away an average of only four days a year.

St. Petersburg grew rapidly during the mid-1900's, partly because many retired persons moved there. It ranked 166th in population among United States cities in 1940, and 61st by 1970. In the mid-1970's, people aged 65 and over made up about 30 per cent of the city's population. St. Petersburg and Tampa form a metropolitan area that has a population of 1,088,549.

During the 1840's, white settlers, mostly farmers and fishermen, first arrived in what is now the St. Petersburg area. Peter A. Demens, a businessman, built a railroad to the area from central Florida in 1888. Demens named the community for his birthplace, Saint Petersburg (now Leningrad), Russia.

Description. St. Petersburg covers about 60 square miles (160 square kilometers). Three bridges link the city with the Florida mainland to the east. Other bridges and highways run between St. Petersburg and several islands in the Gulf of Mexico to the west. The city has about 40 miles (64 kilometers) of shoreline and a deep-water harbor. St. Petersburg also has about 70 public parks and 70 lakes.

The city's chief cultural attractions and recreation areas lie on Tampa Bay, east of the downtown area. Many tourists visit the St. Petersburg Historical Museum and the St. Petersburg Museum of Fine Arts. Bayfront Center and The Pier provide various cultural and recreational facilities. Bayfront Center includes an auditorium, convention facilities, and a sports arena. The Pier extends into Tampa Bay and includes meeting rooms, restaurants, shops, and a miniature golf course. St. Petersburg is the home of Eckerd College and a branch campus of the University of South Florida.

Several major-league baseball teams have held spring training in St. Petersburg since 1914. As a result, the city is called the *Winter Baseball Capital of the United States*. Yachts from various parts of the world compete in sailing races held from St. Petersburg to several Florida cities and Mexico each spring.

Economy. Tourism ranks as St. Petersburg's leading source of income. About $3\frac{1}{2}$ million visitors spend about $900 million there yearly. The city has about 200 small manufacturing plants. Their chief products, in order of value, include electronic equipment, glass products, and boats. The spending of retirement income by the city's many retired residents has an important effect on the city's economy.

Government and History. St. Petersburg has a council-manager form of government. The city council consists of a mayor whom the people elect to a two-year term, and six council members elected to four-year terms. The council hires a city manager to administer the government.

Indians lived in what is now the St. Petersburg area as early as 5000 B.C. Timucuan Indians lived there

when Spanish explorers first arrived in the early 1500's. Whites began to settle in the area during the 1840's. By 1890, about 270 persons lived there. St. Petersburg was incorporated as a town in 1892, and as a city in 1903.

The first of several tourist booms in St. Petersburg began in the early 1900's. The city attracted worldwide attention in 1914, when the world's first commercial airline began to operate there. A boom in land sales increased the city's population from 14,000 in 1920 to about 40,000 in 1930. Gandy Bridge, which opened in 1924, linked St. Petersburg and Tampa. Later, the construction of other bridges helped the city's growth.

St. Petersburg has built several major projects on Tampa Bay. The St. Petersburg Yacht Basin, a harbor for yachts, opened in 1963. Bayfront Center opened in 1965, and The Pier was modernized in 1973. In the mid-1970's, the city started to plan an expansion of Bayfront Center's convention facilities. STAN B. WITWER

SAINT PIERRE AND MIQUELON, *MICK uh lahn,* are two small French islands about 10 miles (16 kilometers) south of Newfoundland. The islands cover a total area of 93 square miles (242 square kilometers), and have a population of about 5,200. They are ruled by an administrator who is assisted by a *privy council,* made up of chiefs of departments. The *general council,* made up of 14 elected members, manages financial and other local affairs. The islands and several small islet dependencies constitute an overseas territory of France.

The rocky islands are important only as a French fishing center. They export codfish. Saint Pierre, the capital and largest town, has a good harbor.

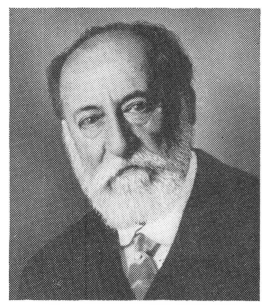
France first occupied the islands in 1635. England and France controlled them in turn until 1814, when France took final possession. In 1956, the French government gave them self-government. ROBERT E. DICKINSON

SAINT ROCH, a ship. See VANCOUVER (Museums); NORTHWEST PASSAGE.

SAINT ROSE, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

SAINT-SAËNS, *SAN SAHNS,* **CAMILLE** (1835-1921), was a French composer. He composed large quantities of music for a great variety of instrumental and vocal combinations. He wrote easily, "as an apple tree produces fruit," he said once. But many of his works are no longer played. Probably his best-known composition is the opera *Samson and Delilah* (1877).

Saint-Saëns composed a "zoological fantasy," *Carnival of Animals,* for two pianos and orchestra in 1886. In this humorous piece, he used the instruments to describe the elephant, kangaroo, cuckoo, lion, swan, and other animals. Saint-Saëns was born in Paris. At the age of 13, he entered the Paris Conservatory. He became a famous pianist and organist. HOMER ULRICH



Brown Bros.

Camille Saint-Saëns

SAINT SCHOLASTICA, COLLEGE OF. See UNIVERSITIES AND COLLEGES (table).

SAINT-SIMON, *SAN SEE MAWN,* **COMTE DE** (1760-1825), CLAUDE HENRI DE ROUVROY, was a founder of French socialism. His ambition was to work for the betterment of mankind. He wanted to bring about a new society in which everyone would have to work, and in which each would receive rewards equal to his labor. No person would be allowed to inherit wealth, and all men would start life on an equal basis. Saint-Simon wanted to base his social theories on scientific evidence, but actually his conclusions were unsystematic.

Saint-Simon was born in Paris. He went to America in his youth and fought bravely in the Revolutionary War. Saint-Simon took no active part in the French Revolution, although he welcomed it. W. T. JONES

SAINT SOPHIA. See HAGIA SOPHIA.

SAINT SWITHIN'S DAY, the feast day of that saint, is July 15. He was bishop of Winchester and the trusted councilor of Ethelwulf, King of the West Saxons, who had him made bishop about 852 (see SWITHIN, SAINT). St. Swithin's name is connected with this rhyme:

> St. Swithin's day if thou dost rain,
> For forty days it will remain;
> St. Swithin's day if thou be fair,
> For forty days 'twill rain nae mair. FULTON J. SHEEN

SAINT TERESA, COLLEGE OF, is a liberal arts college for women in Winona, Minn. It was founded in 1907, and is conducted by the Roman Catholic Sisters of St. Francis. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT THOMAS. See VIRGIN ISLANDS.

SAINT THOMAS, COLLEGE OF, is a Roman Catholic school for men in St. Paul, Minn. Courses are offered in all the major departments of the liberal arts. The college has a graduate program in education. It offers cooperative programs with the College of Saint Catherine, Hamline University, Macalester College, and the University of Notre Dame. The school was founded in 1885. For enrollment, see UNIVERSITIES AND COLLEGES (table). TERRENCE J. MURPHY

SAINT THOMAS, UNIVERSITY OF. See UNIVERSITIES AND COLLEGES (table).

SAINT THOMAS AQUINAS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINT THOMAS SEMINARY. See UNIVERSITIES AND COLLEGES (table).

SAINT VALENTINE'S DAY. See VALENTINE'S DAY.

SAINT VINCENT. See WEST INDIES ASSOCIATED STATES.

SAINT VINCENT, CAPE. See CAPE SAINT VINCENT.

SAINT VINCENT COLLEGE is a liberal arts school for men in Latrobe, Pa. The college is controlled by the Roman Catholic Church, but students of all faiths may enroll. Saint Vincent offers work leading to degrees in the prelegal, pre-engineering, predental, premedical, business, natural and social sciences, humanities, and music fields. It was founded in 1846. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SAINT VITUS'S DANCE. See CHOREA.

SAINT XAVIER COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAINTE-ANNE-DE-BEAUPRÉ, *BOH PRAY,* is a Roman Catholic shrine in Montmorency County, Quebec. It is a place where many miracles are said to have been

Ministère Du Tourisme, Quebec

The Basilica of Sainte-Anne-de-Beaupré is one of the most frequently visited religious shrines in North America.

performed. Hundreds of thousands of ill and crippled men and women have made pilgrimages to the shrine. Hundreds have left their crutches in the church as tokens of their healing. Sainte-Anne-de-Beaupré is known as "the American Lourdes." Lourdes is a French shrine where many are said to have been healed.

An old legend tells how the first chapel was built there during the early days of French settlement in Canada. A boatload of Breton sailors was being tossed about wildly by the waves on the Saint Lawrence River. The sailors prayed to Saint Anne, the patron saint of sailors. They promised to build a chapel in her honor if they were saved. After the storm, they landed where the Saint Lawrence joins the Sainte-Anne du Nord River near Quebec. There they built a church in 1658.

In 1876, a new church was built nearby. Eleven years later, it was created a basilica by papal decree. The splendid church was destroyed in 1922 by a fire that began in the pile of crutches. But a monk saved the relic of Saint Anne and a statue of the saint. The church has since been rebuilt. FULTON J. SHEEN

SAINTE-BEUVE, *sant BURV*, **CHARLES AUGUSTIN** (1804-1869), a French critic, was the greatest exponent of the biographical method of literary criticism. His works reveal that his primary interest was in human psychology and the origin of a literary work in the creator's mind, his family, his friends, and his time.

Sainte-Beuve possessed excellent taste and tireless curiosity. Writing in a delicate and subtle style, he ranged over the entire field of arts and letters, and probably did more than any other man to determine attitudes on French literature in his time. His brilliant essays were published in *Literary Portraits* (1829-1846), *Contemporary Portraits* (1846), 15 volumes of *Monday Chats* (1853-1862), and 10 volumes of *More Monday Chats* (1863-1872).

Sainte-Beuve was also an outstanding historian of French aesthetic and intellectual movements. *Tableau of French Poetry* (1828) is a sympathetic study of the French origins of romanticism. *History of Port-Royal* (1840-1860) examines Port-Royal, a French convent that became the center of a religious and literary movement in the 1600's. *Chateaubriand and His Literary Circle* (1860) is a critical assessment of the French statesman and author and his literary circle during the First Empire in the early 1800's. Sainte-Beuve also wrote poetry and a fine, partly autobiographical novel, *Volupté* (*Pleasures of the Senses*, 1834).

Sainte-Beuve was born in Boulogne-sur-Mer. He studied medicine from 1823 to 1827 before he decided to make his career in literature. Sainte-Beuve spent much of his career writing for newspapers and for literary magazines. ROBERT J. NIESS

SAINTE-CLAIRE DEVILLE, HENRI ÉTIENNE. See ALUMINUM (History).

SAINTPAULIA. See AFRICAN VIOLET.

SAINTS PETER AND PAUL, CATHEDRAL OF. See WASHINGTON CATHEDRAL.

SAIPAN, *sy PAN*, is the second largest island in the Mariana Islands, in the western Pacific Ocean. It lies about 1,600 miles (2,570 kilometers) east of Luzon Island in the Philippines, and about the same distance southeast of Tokyo. For location, see PACIFIC ISLANDS (map). Saipan has an area of 48 square miles (124 square kilometers) and a population of about 8,000. Its former chief town, Garapan, was destroyed during World War II, but its harbor remains one of the best in the Marianas. The island belonged to Spain until 1899, when Germany bought it. A mandate of the League of Nations gave Japan control after World War I. The Japanese planted sugar cane, and built large sugar refineries and heavy fortifications on Saipan.

Saipan was the scene of heavy fighting during World War II. United States forces landed there in June, 1944, and captured the island after several weeks of fierce fighting. Saipan then became an important American air base for further attacks on Japan. After the war, Saipan became a United Nations trust territory under the direct control of the United States. The headquarters of the Trust Territory of the Pacific Islands was moved from Guam to Saipan in 1962. EDWIN H. BRYAN, JR.

SAJAMA. See ANDES MOUNTAINS (Physical Features).

SAKAKAWEA. See SACAGAWEA.

SAKE. See ALCOHOLIC DRINK (Other Fermented Drinks).

SAKHALIN, *SAK uh leen*, is a long, narrow island off the eastern coast of Siberia. It is about 600 miles (970 kilometers) long, and from 16 to 100 miles (26 to 160 kilometers) wide. It has a population of 622,000 and an area of 29,100 square miles (75,368 square kilometers). For location, see RUSSIA (physical map).

Pine and spruce forests cover almost all of Sakhalin. It has a changeable climate and the land is not suited to farming. Most of the people make a living by fishing, and fish is their most important food. Many fur-bearing animals live on the island, and some of the men are fur traders. Coal mining and lumbering are carried on and wood pulp is manufactured.

Dutch navigators were the first to discover Sakhalin.

For many years Russia and Japan quarreled over the island. In 1875, Japan recognized Russia's ownership. But disputes continued until 1905, when Russia and Japan divided Sakhalin between them after the Russo-Japanese War of 1904-1905. Russia took the northern half of the island, and Japan took over the southern half. The Ainu, a race of white men believed to have been the first people in Japan, still live in southern Sakhalin (see AINU).

The discovery of oil on Sakhalin led the Russians to colonize the island in 1931. The defeat of Japan in World War II gave Russia complete control of the island. THEODORE SHABAD

SAKHAROV, *SAH khah roff,* **ANDREI DMITRIYEVICH** (1921-), a Russian nuclear physicist, is a member of the Soviet Academy of Sciences. In 1968, Sakharov wrote and distributed an essay entitled "Thoughts on Progress, Peaceful Coexistence and Intellectual Freedom" without official governmental approval. He urged joint action by the United States and Russia to prevent nuclear war, overpopulation, famine, chemical pollution, and dictatorships. Sakharov worked on thermonuclear research at the Lebedev Institute of Physics in Moscow with Igor Y. Tamm who won the 1958 Nobel prize in physics. WALTER C. CLEMENS, JR.

SAKI. See MUNRO, HECTOR HUGH.

SAKIEH. See EGYPT (Agriculture).

SAL AMMONIAC (chemical formula, NH_4Cl) is a white crystal compound made up of nitrogen, hydrogen, and chlorine. Sal ammoniac is known chemically as *ammonium chloride.* It dissolves easily in water, and gives it a sharp, salty taste. Manufacturers make sal ammoniac by combining liquid ammonia with hydrochloric acid. This compound is then evaporated and purified. Sal ammoniac is sometimes found as a mineral in the lava which is poured forth by volcanoes.

Sal ammoniac has many uses in industry and medicine. Its main use is in the manufacture of electric dry cells. It is also used in making the flux for soldering, in gold refining, and in the textile industry. As a medicine, sal ammoniac is often used to induce spitting up or vomiting in bronchitis, pneumonia, and stomach disorders. GEORGE L. BUSH

SAL SODA. See SODA.

SALADIN, *SAL uh dihn* (1138-1193), was the greatest Moslem warrior of the 1100's. He brought about the Third Crusade by capturing Jerusalem in 1187 (see CRUSADES [The Third Crusade]). The Moslems regarded Saladin as a saintly hero, and even the Christians honored him for his honesty and bravery.

Saladin served as a soldier in the army of Nur-ed-din, Sultan of Syria. The sultan sent Saladin with an army to aid the Egyptian ruler, who was caliph of the Shiite branch of Islam and a rival of the Sunnite caliph of Baghdad (see CALIPH; ISLAM [Sects]).

Saladin entered the service of the Egyptian caliph, and through his ability as a soldier, became *vizier,* or real head of the government. He worked to change Egypt to the Sunnite branch of Islam. Saladin achieved this aim shortly before the Egyptian caliph died in 1171. Then the caliph of Baghdad recognized Saladin as sultan of Egypt.

Saladin extended his rule northward over Damascus, Aleppo, Mosul, and Edessa, and fought the Christian states along the coast. Some of his troops were besieged at Acre in 1189. They surrendered after two years to Richard the Lion-Hearted (see RICHARD [I]). Saladin and Richard made a truce in 1192 which gave the coast to the Christians, the interior to the Moslems, and allowed Christian pilgrims to enter Jerusalem.

Historical Pictures Service

Saladin led Moslem troops against the Christians who tried to recapture Jerusalem during the Third Crusade (1189-1192).

Saladin is remembered also for his support of theologians and other scholars. He built schools, dikes, and canals to help his subjects, and mosques for their worship. When Saladin died, his lands were divided among his less able heirs.

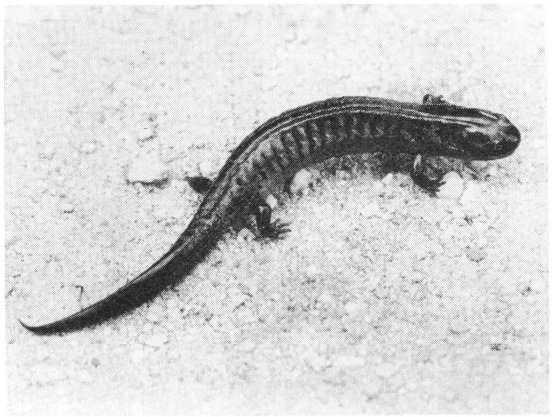
Saladin was born in the castle of Tekrit on the Tigris River in Mesopotamia. His father, a Kurd general, later became governor of Damascus, the center of Moslem learning. FRANKLIN D. SCOTT

SALAMANDER is a timid, harmless animal that looks like a lizard but is related to the frogs and toads. Most salamanders are small, but the giant salamander of Japan grows 5 feet (1.5 meters) long.

Salamanders are cold-blooded animals with moist, slimy skins. They usually have four legs and a long tail. Their bodies can replace lost parts, such as the tail and legs. Salamanders live in streams and ponds, on the land beneath stones, and in caves or rotting logs where it is cool, dark, and moist. They eat grubs, slugs, worms, and insects.

The female salamander usually lays her eggs in early spring. The eggs are deposited one by one, in groups or in long strings. The *larvae* (young) hatch from the eggs at different times. In some *species* (kinds), the larva does not leave the egg. The larva breathes through external gills until it changes into an adult. But some kinds of salamanders keep their larval characteristics throughout their lives.

The *spotted salamander* of North America is one of the best-known species. It is about 6 inches (15 centimeters) long and it has yellow spots on its smooth, dark colored skin. The spotted salamander secretes a milky fluid



American Museum of Natural History

Red Salamanders Live in the Eastern United States.

through its skin when it is roughly handled. This fluid is poisonous to some animals, and protects the salamander from some of its enemies.

Scientific Classification. Salamanders belong to the class *Amphibia* and the order *Caudata*. The spotted salamander is a member of the mole salamander family, *Ambystomidae*. It belongs to the genus *Ambystoma*, and is species *A. maculatum*. W. FRANK BLAIR

See also HELLBENDER; MUD PUPPY; NEWT.

SALAMIS, *SAL uh mis*, is a horseshoe-shaped Greek island in the Saronic Gulf, about 10 miles (16 kilometers) west of Athens (see GREECE [map]). It covers 36 square miles (93 square kilometers) and has a population of about 20,650. Much of the land is rocky and mountainous. Most of the inhabitants are Albanians. They raise grapes, olives, and grain in the valleys and coastal regions. Salamis is also known by a modern name, *Kuluri*, which means *baker's crescent*.

The Greeks and Persians fought a great sea battle near Salamis in 480 B.C. When the Persians advanced after the Battle of Thermopylae, the Athenians sought safety on Salamis. In the Battle of Salamis, Persian ships tried to block the retreat of Greek vessels. The Greeks destroyed half the Persian fleet. C. BRADFORD WELLES

See also NAVY (Famous Sea Battles of History); ARISTIDES; THEMISTOCLES; XERXES.

SALARIUM. See SALT (History).

SALAZAR, *suh luh ZAHR*, **ANTONIO DE OLIVEIRA** (1889-1970), served as dictator of Portugal from 1933 to 1968. He became prime minister in 1932. The next year he proclaimed a new constitution that made him a virtual dictator. He suffered a stroke in 1968 and was unable to carry out his duties. He was replaced as prime minister by Marcello Caetano.

Antonio de Salazar

Consulate General of Portugal

Salazar was a financial expert, and a professor of economics at Coimbra University before he entered government service. He refused the position of minister of finance in 1926, because he felt he would not have enough power to solve Portugal's financial problems. By 1928, Portugal's finances were in such poor condition that the government gave Salazar the power he wanted. He gradually took control of the government.

Salazar set up a police state. He put trade unions under government control, and abolished freedom of the press and political expression. He put Portugal's finances on a firm basis, but he did so at the expense of wages, education, and the well-being of many of the Portuguese people.

During World War II, Salazar kept Portugal neutral. The capital, Lisbon, became the main link between Allied and Axis nations, and their agents operated freely in the country. Yet Salazar maintained Portugal's traditional ties to Great Britain, and granted the Allies naval and air bases in Portugal's Azores Islands.

Political opposition to Salazar began growing in Portugal in the late 1950's. His policies toward Angola, Mozambique, and the other Portuguese colonies in Africa attracted international attention in the late 1960's. Salazar maintained Portuguese domination over the colonies despite disapproval by the United Nations and rebellion by some Africans. STANLEY G. PAYNE

SALE, BILL OF. See BILL OF SALE.

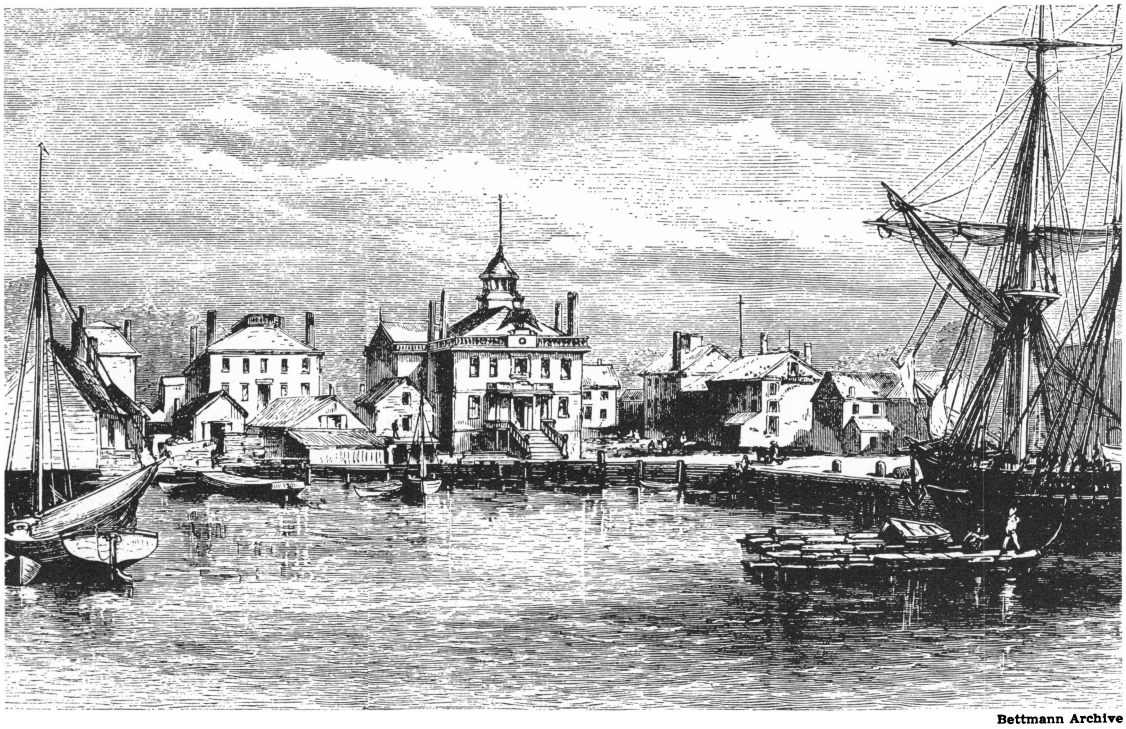
SALEM, Mass. (pop. 40,556), is one of New England's most historic cities. It was the site of the famous witchcraft trials of the 1690's. Around 1850, Salem became a center of the cotton industry. Today, the city's products include cables, flashbulbs, games, lamps, plastics, radio tubes, tannery and leather products, and valves.

Location and Description. Salem lies on a fine harbor, 16 miles (26 kilometers) northeast of Boston. For location, see MASSACHUSETTS (political map).

Salem State College is located in Salem. The city's many historic houses include the birthplace of Nathaniel Hawthorne and the House of Seven Gables, about which he wrote his famous novel. Other beautiful homes, built by wealthy sea merchants, line Chestnut Street. The Essex Institute and the Peabody Museum have preserved many relics from the voyages of Salem ships. The Salem Maritime National Historic Site, which covers 10.73 acres (4.34 hectares), has buildings that were significant in New England's maritime, architectural, and literary history. The first settlement in Salem has been reconstructed as Pioneer Village. Another historic site in Salem is the Witch House, where the preliminary hearings for the witch trials were held.

History. Roger Conant and colonists from Cape Ann established the first settlement on the site of Salem in 1626. In 1628, John Endecott led a group of settlers into the Salem area for the Massachusetts Bay Company.

Salem's witchcraft scare began in 1692. One of the servants of a local minister was a West Indian slave girl named Tituba. She told voodoo tales to a group of young girls. The girls became so excited by her stories that they shivered and screamed at night. A physician who examined them said they were bewitched. Tituba and two other women were accused of being witches and were sentenced to death. The witchcraft scare continued



Bettmann Archive

The Harbor at Salem, Mass., Became the Home Base for Many Privateers Who Operated in the Revolutionary War.

for about a year. Nineteen persons were hanged as witches on Gallows Hill and one was pressed to death. See SEWALL, SAMUEL; WITCHCRAFT.

During the Revolutionary War, Salem became a great privateering port. When peace came, Salem merchant ships sailed to all parts of the world. Salem captains traveled around the Cape of Good Hope to reach the Far East. Salem again became a privateering port in the War of 1812. However, war losses, the increasing shallowness of the harbor, and the opening of the Erie Canal ruined Salem's trade.

Salem received its city charter in 1836. It has a mayor-council form of government. WILLIAM J. REID

See also COLONIAL LIFE IN AMERICA (picture: Witch House).

SALEM, Ore. (pop. 68,480; met. area 186,658), the state capital, lies on the Willamette River about 50 miles (80 kilometers) south of Portland. It has food-processing and metal, paper, and wood products industries. Salem began as the village Chemeketa. It was named Salem in 1846, and received a city charter in 1857. Salem was chosen as the state capital in 1864. It is the home of Western Baptist Bible College and Willamette University. The city is the seat of Marion County. It has a council-manager government. For location, see OREGON (political map). RICHARD M. HIGHSMITH, JR.

See also OREGON (picture: The State Capitol).

SALEM COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SALEM STATE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SALEM WITCHCRAFT TRIALS. See SALEM (Mass.); WITCHCRAFT.

SALERATUS. See SODA.

SALERNO, *sah LAIR noh* (pop. 123,589), is the seaport capital of the province of Salerno in Italy. An Italian Mediterranean shipping center, it lies on the Gulf of Salerno, about 30 miles (48 kilometers) from Naples (see ITALY [political map]).

Salerno was the seat of an early medical school from the 1000's to the end of the 1200's. Some of the churches in the city, including the Cathedral of San Matteo, were built during the same period, when the Normans controlled Salerno. During World War II, Allied troops landed in Salerno in September, 1943, and captured the city from the Germans. SHEPARD B. CLOUGH

SALES, SAINT FRANCIS DE. See FRANCIS DE SALES, SAINT.

SALES ENGINEER. See ENGINEERING (Engineers at Work).

SALES TAX is levied on the sale of goods and services. The tax is a certain percentage of the sale. The sales tax may be used by a city, state or province, or national government. It can be collected by the producer, manufacturer, wholesaler, or retailer. It may be levied on selected items or on every sale. The rate is usually low, although a high rate may be levied on luxury goods such as furs, or on such items as gasoline, tobacco, and food.

The main objection to most sales taxes is that they fall heavily on low-income groups. Persons with low incomes must spend much of their wages on consumers' goods. So they pay more sales tax in relation to their incomes than wealthy people do. The main advantages of the sales tax are that it produces a great deal of money, it reduces government reliance on income taxes, and it is relatively easy to administer. CHARLES J. GAA

SALESIAN. See BOSCO, SAINT JOHN.

WORLD BOOK photo

Good Salesmanship uses the same principles whether a salesman is selling television sets or shoes. A salesman in a TV store, *above*, describes the features of a portable set to a couple.

SALESMANSHIP is the capacity to get people to act. It is the ability to persuade other persons to support an idea willingly and happily, to buy a product, or to take a service.

Some persons used to say that salesmen are born, not made. But most persons now know that many specific methods of salesmanship not only *can* be learned, but also *must* be learned, if a person is to lead the most happy and most successful life of which he is capable.

Everybody Is a Salesman

Salesmanship is an art, and it also approaches being a science. It is perhaps the most human of arts and sciences, because it has the most human basis of all the arts and sciences. In its broad meaning, salesmanship enters into almost every human activity. The boy who persuades his playmates that they would rather play one game than another is using salesmanship. The job-seeker must use salesmanship to convince the employer that he is worth hiring. An employer, too, often has to use salesmanship to hire an employee whom he wants, and then to get him to do his work in certain ways.

Salesmanship is used in almost every occupation and profession. A man who repairs automobiles in a garage seldom thinks of himself as a salesman. But the courtesy with which he does his work, and the way in which he explains what needs to be done and how he proposes to do it, may determine whether or not the owner of the car will return to the garage for more service.

It is almost as important for a doctor to inspire the confidence of his patients as it is for him to have a broad knowledge of medicine. His "bedside manner" is salesmanship of a high order. A trial lawyer's job is much like that of a salesman. He must convince a judge or jury of the truth and justice of his case. That, too, is salesmanship.

The genius of a great scientist or inventor would never be of maximum benefit to mankind without being accompanied by good salesmanship. The electric light, the washing machine, and the refrigerator might still be laboratory toys if there had not been men with the power to convince people that such newfangled gadgets would benefit them. In a very real sense, salesmanship is education of the people to higher and better standards of living.

Salesmanship as an Occupation

In its narrower and more common meaning, salesmanship refers to the processes by which most goods and services are sold for use, or for resale. There are many different kinds of salesmen. There are those who sell such products as vacuum cleaners, insurance, or common household products, by approaching their customers directly in their homes or offices. Other salesmen sell products which are to be used in certain kinds of businesses or factories. These salesmen visit only those companies which are likely to use their product. Still other salesmen represent wholesale houses which sell their products for resale to stores. The stores themselves have retail clerks who make up another class of sales personnel. Still another class of persons sell their services.

They include laundry operators, automobile repairmen, television and home-appliance servicemen, and dry cleaners.

History of Salesmanship

Salesmanship has existed in a crude form since very early times. Primitive tribes traded food they raised or articles they made for the goods of other tribes. Early people bargained with each other to get as much as possible in return for their products. And in their bargaining they used many of the basic principles of salesmanship for personal persuasion.

Salesmanship took another step forward when money came into use. We know that the early Phoenician traders used money in their trade. Through the use of money they made it possible to sell goods without having to receive anything of practical value in exchange. The use of money expanded trade and in turn expanded salesmanship. But salesmanship as we know it today is a fairly recent development. Until about two hundred years ago the vast majority of all peoples bought very little goods. They made at home nearly everything they needed. They grew their own food, and they made their own clothing. They made the implements they needed for doing their work.

However, some peoples made more articles or grew more food than they actually needed, and they traded these goods for things which they were not able to make for themselves. In the towns, people began to make special kinds of goods. Cobblers made shoes, tailors made clothing, and metalsmiths made tableware and jewelry. Some of these made fairly large quantities of goods and during the Middle Ages some persons traveled from one place to another to sell or trade their surplus goods for raw materials.

But communication and transportation were so limited that selling goods at a distance was difficult. Carrying products over great distances made them too expensive for the average person to buy. So selling was only on a small scale. Yet in England during the time of Queen Elizabeth I, some merchant trading organizations developed in the manufacturing towns. They collected goods and brought them to the coastal towns where they were exchanged for foreign goods. In turn, the organizations' goods were shipped to foreign markets.

Woodcut by Charles Green Bush; Bettmann Archive

Yankee Peddlers traveled throughout the land during the 1700's and early 1800's. Most came from New England. They went from house to house selling such goods as brooms and cloth.

Modern salesmanship began to develop during the Industrial Revolution of the 1700's and early 1800's. The Industrial Revolution introduced into selling three major elements. These were mass production, the invention of radically different products, and competition in business.

Mass Production. The most important thing the Industrial Revolution did was to replace hand labor with machinery. Machines produced articles more quickly and more cheaply than people could make them by hand. Soon there began to be more articles than people actually needed, and they were produced so cheaply that the common people could afford to buy them. Luxury goods came into the reach of the average person.

But people did not start buying merely because goods were available. It was necessary to educate and to persuade people to buy. Goods had to be sold rapidly if the manufacturer was to stay in business. Many manufacturers did not have time to find their own markets and sell their own goods. So there developed the sales agent for the manufacturer. These agents, or wholesalers, bought the manufactured goods and took the risk of distributing them. They sent salesmen to the various cities to sell the goods. At first the salesmen took the goods with them. But in those days, roads were often unsafe because there were many robbers. Also it proved to be expensive to haul goods great distances, when it was not certain that they would be sold. So these "chapmen," or "bagmen," as the salesmen were called, began to take only samples of their wares with them. They showed them to prospective customers and took orders for the goods. The goods were delivered only after orders were taken. These salesmen became the first traveling salesmen as we know them today.

Invention of New Products. Another development of the Industrial Revolution was the invention of many new products. However, people often had to be persuaded that the new articles would be useful to them. At first many new inventions were laughed at. For example, Elias Howe patented the first practical sewing machine. But it took Isaac M. Singer to sell the public on the value of the sewing machine in the home.

Most people are naturally slow to try the new. They must be convinced that a new product is good and useful. The salesman acts as a teacher to explain to people how they can make their lives more comfortable by using new products. In this way salesmen have improved the world's standards of living.

Competition. As the Industrial Revolution progressed, there was greater and greater competition among manufacturers. Soon many different plants were making similar products. It took salesmen to convince the public that one product was better than another.

Nowadays, selling is a vital part of the economic system. Even when goods are scarce and it is comparatively easy to find customers, salesmen are needed to distribute goods, to act as the servicing and informational link between seller and buyer, and to maintain good-will relationships.

Salesmen also play a large part in creating the wealth that makes production of goods possible. This is brought about in the following manner. The salesmen get people to buy goods. The money that the salesmen bring to their companies makes it possible for those

WORLD BOOK photo

Samples Help Salespeople Sell Their Products. The saleswoman, *center,* is demonstrating to a family the special features in a sample volume from a set of reference books.

Union Special Corporation (WORLD BOOK photo)

Videotape Recordings store television pictures and sound. The sales talk of a student salesman, *right foreground,* may be videotaped so he later can evaluate his performance on special TV.

companies to improve their products and to make them in greater quantities. Greater production creates more jobs, and the workers use their wages to buy other products.

Basic Selling Techniques

Selling is essentially a human relationship, so it is not possible or practical to confine its procedures to any rigid rules. But there are certain fairly well defined paths which successful salesmen follow and some basic techniques of salesmanship on which most salesmen are generally agreed.

Finding the Prospect. The income of the average salesman is based on how much he sells. His income will be low if he spends his time in trying to sell his goods to persons who are not likely to buy. He can save time in the long run by carefully selecting and qualifying possible customers, or prospects.

The problems of finding prospects depend largely on what the salesman has to sell. For salesmen who sell essentially needed products, this problem is not great. For example, the salesman of shoemaking machinery knows that only shoe factories will buy his goods. Similarly, the salesman of a brand of expensive food would not try to sell his goods to a store whose customers had little money.

The salesman may find customers by writing letters to possible prospects before he calls, with a view to developing inquiries or requests for more information from such prospects. The salesman then calls only on the people who have made inquiries. This way of getting "leads" is called "direct mail."

Salesmen of products which are in general use may rely on door-to-door canvassing. Tactful questioning of buyers may give the salesmen the names of neighbors or friends who would be good prospects.

Preparing for the Interview. A sales interview should be carefully planned. The salesman who goes to see a prospect with little idea of what he is going to say or do will not last long. Many sales manuals prepared by companies for their salesmen provide outlines of presentations. Other manuals give sales talks with directions as complete as the stage directions of a play. These companies require that a salesman should rehearse his interview as carefully as an actor rehearses a play. And he is asked to learn his part so well that he gives a sincere and convincing performance. Other companies prefer that their salesmen rely on no memorized presentation, but that they follow certain general patterns of persuasion which other salesmen have proved to be effective.

In any event, a salesman should enter his sales interview with a specific idea about how his product can be useful to the prospect. Therefore, it is necessary that he have as full an understanding as possible of the nature of his prospect's business.

Knowledge of the prospect's business involves also knowledge of whom the salesman should see to make his sale. Some companies have buyers or purchasing agents who make the decisions on what should be bought. Generally these decisions are influenced by certain specifications or requirements which the engineering or production departments of their companies have developed. Other companies rely on their department heads or their presidents to decide on purchases.

A salesman must be prepared to make a quick estimate of his prospect's characteristics and to adapt himself to them. Some persons like to work rapidly and come to a quick decision. Other persons' minds move more slowly. They prefer to come to a decision only after considerable discussion. The salesman should try to judge the mental inclinations of his prospect and shape his sales talk to fit such habits of thinking. Some prospects tend to be distrustful. Others tend to be emotional in their make-up. Still others are coldly logical. A few are very professional in insisting that certain "pet" ideas of their own be complied with. By engaging the prospect in preliminary discussion of other matters, the salesman often can gauge the prospect's probable manner of thinking.

The Sales Presentation. What is said in a sales talk depends largely on what is to be sold. A clerk in a grocery store usually does not need to do much more than arrange the merchandise attractively and con-

veniently and help the shopper meet her immediate needs. But a grocery clerk can increase sales by emphasizing the reliability of certain brands of goods. He can also make helpful suggestions about the use of new products that have come on the market.

But the salesman who is trying, for instance, to get a large manufacturing corporation to use the packing cartons which his own company makes has an entirely different problem. He knows his prospect is a possible customer. He knows also that the prospect has to be convinced of the superior value of the salesman's product.

The most successful salesman is the one who can put himself in the position of the prospect, and understand his problems, his needs, and his desires.

Motives and Emotions. There are a number of basic human motives and deep-running emotions that are mainsprings to action. Every one, for example, seeks to acquire and to own different forms of wealth. These may be lands, goods, or money. Some people like to own farms or homes. Others like to possess automobiles, clothes, and jewelry. Still others like to make profits, accumulate money as such, or to own stocks and bonds.

The alert salesman may show that his lands or goods will produce more money, or more additional goods and lands than the prospect can get by keeping his money. He shows that what he sells will produce more for the prospect than the price asked for it. Profit is the motive for buying.

Every person likes to be well thought of by others. He strives for a good name. If the salesman can show that the "best people" are joining his association, or supporting his program, many prospects will be persuaded to follow their example.

When the salesman can show that what he proposes will make a man's heart stouter, his head quicker, or his mind faster or better informed, he employs still another motive for buying. That is why people buy books and magazines, why they join reading clubs, and why they seek education.

If a salesman can show that his article will ensure health and prolong life, he has a strong selling motive. Medicines, tonics, vitamins, sanitariums, rest retreats, and travel tours are sold on this basis.

Almost every one will act for the benefit of some one whom they love, for their family, or for their friends. Men buy homes to please their wives and children. They take out insurance to protect them. They send their children to school to educate them.

We all like things of beauty, objects of art, and of personal adornment, beautiful sunsets, good music, moving drama, and delicious foods. They all create pleasurable sensations. Good salesmen show that their product has pleasing proportions, harmonious colorings, and that it is good to the eyes or to the taste.

Wealth, profits, good name and fame, personal power, fine health, worthwhile service, and pleasurable sensations are some of many motives that inspire action.

Emotions also are highly important when it comes to getting action. Confidence and fear, pride and shame, love and hate, envy and admiration, respect and contempt, courage and caution—all these emotions play their part in moving people to act.

Effective salesmen combine appeals to motives and emotions to good advantage; at the beginning or in the middle of their presentation they show how their product, service, or idea will add wealth, health, reputation, power, or pleasure. Then toward the end of their presentation, they inspire their prospects with confidence and pride in taking the action which they propose. They show the position of honor and respect that accompanies such action. They point out how the purchaser may be the envy of others, or what joy they will afford their families. The motives and emotions, thus taken together, make for action.

Selling is not entirely a matter of talking about the product. Many a buyer has bought one product instead of another equally good product simply because the salesman of the first product showed more sincerity and eagerness to serve than did the salesman of the other product. Once the salesman is fully informed about his product and its uses, and the reputation, achievements, and capacity of his company, he will do well to add his own qualities of personal agreeableness. He should like the prospect, and seek to get the prospect to like him. Liking often grows out of common interests. The successful salesman will try to find out if his prospect likes golf, fishing, or stamp collecting. He will then try to build up a personal relationship through such interests. But he should not rely on this personal relationship alone to sell his goods.

The Introduction and Description of the Product itself is an important element in a sales presentation. First of all, the salesman must believe wholeheartedly in his product. He must understand how it works, how it is made, and how it can be used. He must be able to answer all questions about it without any hesitation and with complete directness.

It is not enough for the salesman to present his product and let it sell itself. He must in a sense act as the eyes of his prospect. Some buyers know exactly what they are looking for in a product, and are expert enough to judge the product without the salesman's help. But most persons must have a product explained to them, and have its good qualities pointed out. The successful salesman does this.

The salesman should develop the ability to dramatize his product. The successful actor makes himself felt by his audience as a distinct personality. The successful salesman makes his product recognized as something special. He may do this by pointing out how it is better than other similar products. Or he may describe the special research that was conducted to make the product as good as it is. He may make a demonstration of his product. Or he may use special literature to describe its qualities. The salesman must plan how to present his product in the best possible way.

Overcoming Sales Resistance. One thing which the salesman must learn to handle is "sales resistance." Most people are naturally cautious about spending their money, and they may make many objections to a product before they buy it. A salesman may train himself to meet many of these objections beforehand. The salesman can develop certain fairly standard answers for certain typical objections that he frequently receives. Much of this understanding comes only through experience.

A salesman should anticipate his customer's objec-

tions. He always should treat such objections with respect, even though he knows that they are not valid ones. Quite often such objections are based on fears instead of on facts. In such cases, the salesman can say, "I know how you feel. Some of our customers felt the same way at first, but here is what they have found out."

He must be trained to answer quickly any questions his customers may ask, and be ready to admit faults that are obvious, but be quick to show that the merits outweigh the faults. Failure to do so will make the prospect doubt the salesman's honesty and sincerity.

Often, objections can be turned to the salesman's advantage. Suppose the prospect says the price is too high. The salesman can then point out the valid reasons why the price of his product is higher than that of other comparable products. He can show that his product is made of better materials, has better workmanship, and will last longer. He may be able to show that his product is cheaper in the long run than other, less well-made products.

Repeat Sales. One of the main problems of a salesman is the assurance of repeat sales. The bases of successful repeat salesmanship are satisfactory quality, pricing, and service by the company, and complete honesty by the salesman. A buyer will continue to buy from a firm's salesman only if he has complete confidence in him, in the firm, and in its product. A salesman's honesty appears in several stages of the selling process. First, he must never make claims about his product which are not true. The buyer will soon find out that they are not true and will not buy again.

Second, a salesman should not try to sell a product to a person who does not really need it. He may succeed in making the first sale, because of his salesmanship ability. But in the long run the customer will feel that he has been led into making a bad purchase, and the salesman will lose his good will.

Third, the salesman should never make promises unless he is sure they can be fulfilled. If a customer asks for a certain service, the salesman should not promise to perform the service if he or his firm cannot perform it. Yet the salesman can do many things to build good will and to help his customers. For example, a salesman whose product is sold in retail stores can give the proprietor ideas on displays which will help sales. This, in turn, will allow the salesman to sell more of his product to the store owner.

Repeat sales depend a great deal on the personality of the salesman. "High-pressure" salesmen who exaggerate values, make strong statements without proof, and rush their prospects into action without giving them time for investigation or reflection, may be successful in first sales. But they often lose out in repeat sales because their tactics anger their customers. The most successful salesmen in the long run are those who are straightforward in their dealings.

Other Aids to Selling. There are many modern aids to salesmanship. The wise salesman makes the fullest use of these aids. One of the greatest selling aids is advertising. Often a customer first becomes acquainted with a product through a radio or newspaper advertisement. The salesman should closely follow the advertising of his product and make full use of the selling points which it offers him. See ADVERTISING.

The salesman is also often equipped with literature and with picture displays which he can use effectively in his work. Sometimes he has samples of his product to show, or models by which he can demonstrate the product. Such visual aids to selling are very helpful. It has been proved that most persons can understand something they see much more easily than something they hear about.

Magazines and books on products or on the art of salesmanship are also helpful to salesmen. Nearly all businesses have trade publications which describe the latest developments in their fields. The salesman should keep up to date not only on his own company's improvements, but also on those of his competitors. He should look constantly for new ideas in salesmanship.

Qualifications of a Good Salesman

There are a few basic qualities which are helpful to almost all persons who want to sell.

Industry. A salesman does not punch a time clock. Moreover, even though he works long hours, as he should, his actual talking time to prospects is seldom more than two hours a day. This requires that the salesman be alert to find the "free time" of his prospect, and fit his calls and hours accordingly. It means also that he should so organize his day's work and his calls that he uses the least possible time in going from place to place. Where possible, appointments should be made in advance to cut down the time of waiting to see prospects.

Loyalty. The salesman must be loyal to his employer and to his company's products and policies. But he need not be a rubber stamp, blindly doing as he is ordered. He is expected to offer new ideas and critical suggestions. But once the company has made a decision as to how its business is to be conducted, the salesman should follow that decision. The success of a company as a whole depends a great deal upon the uniform way in which a sales program is carried out.

Initiative and Originality. The salesman should always be alert to the need for changes in his personal selling methods. He should be sensitive to his prospect's attitude and be ready to adapt himself to it.

Sincerity and Enthusiasm. No one should ever try to sell a product about which he is not enthusiastic. Prospects are quick to sense that the salesman does not believe what he is saying. A successful salesman must have complete confidence in himself and his product. This confidence will then be carried over to the prospect.

Courage and Foresight. Business conditions constantly change. The salesman should have the imagination and the knowledge of his field necessary to foresee these changes. And he should have the courage to change his methods to fit new conditions. He also must have the determination to keep on presenting his product, no matter how discouraging immediate results may be. In the long run, he is certain to enjoy reasonable success if he has the heart to continue to make as many presentations each day as he can crowd in.

Leadership. The qualities that make up a good salesman are much the same as those that make people good leaders. The boy who leads the games at a party, the girl who organizes the school clubs, the woman who does the real work in organizing public-welfare cam-

paigns—these people are likely to make good salespersons. They have the extra drive and the willingness to work which make for success.

Understanding. A salesman should have a thorough understanding of human nature. His job is basically a job of personal relationship. He must make people like him and respect him through his sympathetic understanding of others.

Personality. Psychologists sometimes divide people into two classes, which they call *introverts* and *extroverts*. Introverts are "turned in" on themselves. Their primary concern is their own problems. The extroverts are "turned out." They are more interested in other persons than in their own inner thoughts and worries. Most successful salesmen are extroverts. Their cheerfulness, enthusiasm, diplomacy, and open-mindedness make it easy for them to get along with people.

Ability to Talk. A salesman is, in a sense, a showman. Like a showman, he must be able to talk well and intelligently. If he talks hesitantly and without confidence, he annoys his prospects. They doubt the truth of what he is saying. At the same time, a salesman should be a good listener, and, at the start of his interview, a good questioner, so that he can know his prospect's situation, and so determine how his company and his product can best be of use.

Personal Appearance. A salesman should always be careful of his personal appearance. Some people make up their minds about a person from their first impression of him. Personal mannerisms are also important. Peculiar habits of speech often make a prospect feel uncomfortable, or even dislike the salesman. A salesman must try to see himself as others see him. He should try to analyze his own behavior and see whether he has any bad mannerisms which will tend to annoy people.

Good Manners. Courtesy and tact play a large part in successful salesmanship. The successful salesman is one who makes his prospect happy to buy, not just happy to get rid of him. He must be convinced that he is doing his prospect a service by trying to sell him his product. But he must never give the appearance of trying to force his prospect to buy.

Careers in Selling

More persons in the United States are employed in selling jobs than in any other occupation. Salesmanship offers almost unlimited opportunities for personal advancement to energetic young men or women.

The best training for salesmanship is a broad, general education. But certain specific courses are valuable for the would-be salesman. Courses in English, psychology, logic, letter writing, bookkeeping, and other commercial subjects will help him acquire helpful skills in business and knowledge of business practices. Many high schools and colleges also give courses in merchandising and salesmanship. A training in public speaking and in dramatics may develop the salesman's ability to talk and give him more confidence. There are also special books on salesmanship which will help him.

Selecting the Job. A sales job should be selected as carefully as any other occupation. Working conditions vary considerably from one selling position to another. Many salesmen must travel a great deal. For persons who do not like to be away from home for long periods, such jobs would not prove satisfactory. Selling demands hard work and long hours. People who do not have much physical strength can not perform such a job satisfactorily. Possibilities for advancement also influence the selection of a selling job.

Perhaps the most important point in selecting a selling job is the salesman's major interest in any product. Is it in how it works? Or is it in what it does? If the salesman's special interest is in how a product works, he probably will be more successful in selling to manufacturers and wholesalers. If his special interest is in what a product does, he very likely will be more successful in selling to consumers, or users.

Income and Advancement. There is perhaps a greater range in the income of salesmen than in any other occupation. Some salesmen work on a salary basis, usually with bonuses for good sales records. Sometimes, bonuses earned in a year amount to more than the salesperson's annual salary. Other salesmen work entirely on commission.

A salesman has an excellent chance to gain a broad knowledge of his company and the industry in which it operates. Often, salesmen with special ability rise to important positions in their firms. Salesmen may become district or general managers of the sales organizations, and from there they may be promoted to executive positions in the home office.

BENJAMIN F. BILLS

Related Articles. See the sections on Careers in various articles in WORLD BOOK. For example, see: AIR CONDITIONING; AUTOMOBILE; BUSINESS; INSURANCE; IRON AND STEEL; PETROLEUM; PLASTICS; PUBLISHING; RADIO; REAL ESTATE; TELEVISION.

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Questions

What is salesmanship? Explain.

How may an employer, a doctor, or a lawyer have to use salesmanship?

How did the first use of money affect salesmanship?

Who were perhaps the first modern traveling salesmen?

What is "sales resistance"? How does the salesman try to overcome it?

What training is especially desirable for a salesman?

What is perhaps the most important point in selecting a selling job?

SALFORD, *SAWL furd* (pop. 128,740), is an English manufacturing city 3½ miles (5.6 kilometers) west of Manchester. It has large cotton, iron, and chemical factories. It is on the Manchester Ship Canal. For location, see GREAT BRITAIN (political map).

SALIAN. See FRANK; SALIC LAW.

SALIC LAW was a set of laws written in Latin and founded on Germanic customs and procedure. Historians believe Clovis (466?-511), king of the Salian Franks, had the Salic laws drawn up during his reign. Parts of the Salic Law listed fines payable to relatives of free persons who were killed, injured, or insulted.

In the 1300's, the Salic Law played an important part in the history of France. The last son of Philip IV died without leaving any direct male heirs. French lawyers used the Salic Law to keep Edward III of England from gaining the throne of France. Edward was the son of a daughter of Philip IV, and the French argued that a kingdom could not be inherited through a woman. Actually, the Salic Law had said nothing about the inheritance of kingdoms. It simply stated that Salic land could not be inherited by women.

The French recognized Philip VI, the son of a brother of Philip IV, as king of France. As a result, Salic Law came to mean that a woman or descendants of a woman could not inherit royal authority. WILLIAM F. MCDONALD

SALICIN. See WILLOW.

SALICYLIC ACID, *sal uh SIHL ihk* (chemical formula, $C_6H_4(OH)COOH$), is the foundation of one of the most popular home remedies, *aspirin* (acetylsalicylic acid). The pain-relieving qualities of this compound, together with its comparative harmlessness, make it a popular drug throughout the world. Another salicylic acid derivative is *oil of wintergreen* (methyl salicylate). This oil is a flavoring for candies, chewing gum, and soft drinks.

Salicylic acid occurs as colorless needle-shaped crystals of a sweetish acid taste. It dissolves a little in cold water and readily in hot water, ether, or alcohol. It may be extracted from oil of wintergreen, but more often it is made from sodium phenate and carbon dioxide.

Salicylic acid is a powerful poison for the bacteria that cause food to spoil, and formerly was used as a food preservative. Salicylic acid is used in treating ringworm and eczema, and in making dyes. GEORGE L. BUSH

See also ASPIRIN; SALOL.

SALINA, Kans. (pop. 37,714), is the chief business center of north-central Kansas. It stands on the banks of the Smoky Hill River, about 180 miles (290 kilometers) west of Kansas City (see KANSAS [political map]). Salina lies in the hard winter-wheat belt of the Middle West, and ranks high in the production of flour. Other important products of Salina include farm implements, flour mill machinery, playground equipment, and foodstuffs. It is the home of Kansas Wesleyan University, St. John's Military School, and Marymount College. Salina is the seat of Saline County, and it has a council-manager government. WILLIAM F. ZORNOW

SALINGER, J. D. (1919-), is an American author whose novel *The Catcher in the Rye* (1951) ranks as a minor classic. The book became especially popular among American high school and college students. The hero and narrator of the story is Holden Caulfield, a prep school dropout in search of self-understanding and a meaning for his life. His misadventures in New York City—with his sister, a girl friend, a prostitute, and others—are comic on the surface but agonizing for Holden. In the end, Holden learns to face the ugliness in life and the weakness in himself.

Salinger also wrote *Nine Stories* (1953), which, like *The Catcher in the Rye*, deals with the loveless. His later fiction has centered on the Glass family in such books as *Franny and Zooey* (1961); and *Raise High the Roof Beam, Carpenters* and *Seymour, an Introduction*, published together in 1963. Of the seven Glass children, Seymour, who commits suicide, best represents the desperate search for lost innocence and the mystic bliss that is glimpsed by Salinger's major fictional characters. Salinger was born Jerome David Salinger in New York City. EUGENE K. GARBER

SALISBURY, *SAWLZ bur ee*, or NEW SARUM (pop. 35,890), lies about 80 miles (130 kilometers) southwest of London, in southern England (see GREAT BRITAIN [political map]). Salisbury is famous for its cathedral, the top of whose spire is 404 feet (123 meters) from the ground. The cathedral was built as part of a new town to replace the town of Old Sarum in the 1200's. All that remains of Old Sarum is a large mound with *ramparts* (defensive banks) made of earth. Stonehenge, the largest prehistoric structure in western Europe, stands near Salisbury (see STONEHENGE). JOHN W. WEBB

SALISBURY, Md. (pop. 15,252), is the largest city on the Eastern Shore of Maryland. It ranks second only to Baltimore among the ports of the state. Salisbury lies near the center of the Delmarva Peninsula (see DELMARVA PENINSULA). Its plants produce canned goods, building materials, paper boxes, creosoted products, brass, iron, shirts, gasoline pumps, and ships. Salisbury was founded in 1732. The city is the seat of Wicomico County. Salisbury has a mayor-council form of government. FRANCIS C. HABER

SALISBURY (pop. 180,000; met. area 380,000) is the capital of Rhodesia (formerly Southern Rhodesia). Until 1963, it was the capital of the Federation of Rhodesia and Nyasaland. The city lies on a plain near the Hunyani River, in an area that produces tobacco and corn. About a fourth of the people of Salisbury are Europeans. Salisbury is a modern city. Cecil Square, in the center of the city, was named for Cecil Rhodes, the founder of Rhodesia. HIBBERD V. B. KLINE, JR.

SALISBURY, MARQUIS OF (1830-1903), ROBERT ARTHUR TALBOT GASCOYNE-CECIL, was a distinguished British statesman who served as prime minister three times. He entered the Cabinet in 1867 and again in 1874 as secretary of state for India under Prime Minister Benjamin Disraeli. In 1878, he became secretary of state for foreign affairs. When Disraeli died in 1881, Salisbury became leader of the Conservative Party and then prime minister. He served from June 24, 1885, to Feb. 6, 1886; from Aug. 3, 1886, to Aug. 8, 1892; and from July 2, 1895 to July 12, 1902. During most of this period of Conservative domination, Salisbury also served as secretary of state for foreign affairs.

Salisbury was born in Hatfield in Hertfordshire, and was educated at Oxford University. He was elected to the House of Commons in 1853, and remained a member until the death of his father in 1868 gave him a seat in the House of Lords. JAMES L. GODFREY

SALISBURY CATHEDRAL. See CATHEDRAL.

SALISBURY STATE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

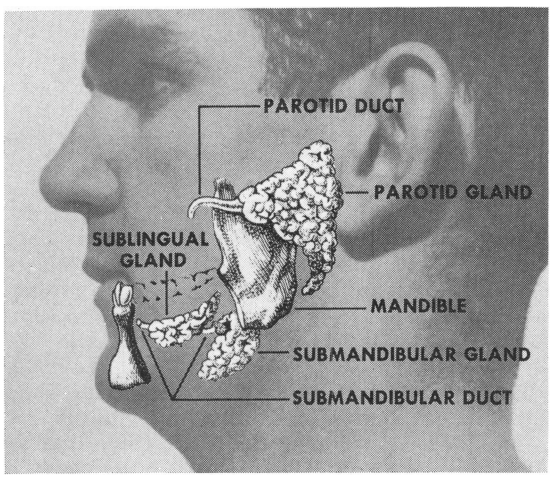
SALIVA, *suh LY vuh*, a sticky fluid produced in the mouth, is important to the digestion of food. It has a colorless and watery appearance. It contains some mucus and produces an *alkaline* (acid-neutralizing) chemical action. Saliva contains an enzyme called *ptyalin*. Ptyalin changes starches into simpler substances called *maltose*.

Saliva moistens and softens all food that is taken into the mouth. It helps in the chewing and swallowing of food. It also keeps the mouth moist, which is important to comfort. Its most important action is on starchy foods. Saliva breaks down all starches into maltose, the first step in digestion.

Three pairs of glands in the mouth and cheeks, known as *salivary glands*, produce saliva. One pair of glands, the *parotid*, is located in front of the ears. Another pair, the *submandibular*, is located under the lower jaw. The third pair of glands is located under the tongue and is known as the *sublingual*. There are several other small glands in the mucous membrane of the mouth that aid in producing saliva. EWALD E. SELKURT

See also MASTICATION.

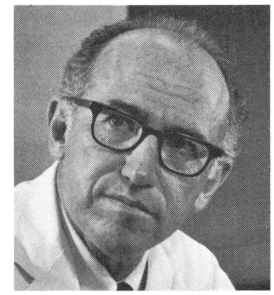
Saliva is produced by three pairs of glands, the *sublingual*, the *parotid*, and the *submandibular*. Saliva helps digest food.



SALIVARY GLANDS. See SALIVA.

SALK, JONAS EDWARD (1914-), an American research scientist, works in the field of preventive medicine. He gained his greatest recognition for developing a vaccine that became the first effective weapon in preventing poliomyelitis (see POLIOMYELITIS). Albert B. Sabin later developed an effective oral polio vaccine (see SABIN, ALBERT B.). Salk also made significant contributions to our understanding of influenza, a severe infectious disease. Both poliomyelitis and influenza are caused by viruses, the microorganisms which are the smallest germs (see VIRUS).

Vast amounts of material relative to immunity had accumulated since "the golden age of bacteriology" during the last half of the 1800's. Salk's task was to distill this information and apply the findings to his preparation of a polio vaccine. He found it necessary to weaken the virus with formalin without knocking out its ability to stimulate the body to produce protective antibodies. Since each type of microorganism has its own antibodies, Salk's vaccine contained all three polio virus types recognized at the time (see ANTIBODY).



The Salk Institute

Jonas E. Salk

The Salk Vaccine. In 1953, Salk announced the development of a trial vaccine. The viruses it contained had been killed with a formaldehyde solution. Among the first to receive the vaccine were Salk, his wife, and their three sons. The vaccine was found safe, and there was considerable evidence that it was effective.

It was further tested during a mass trial in 1954, when 1,830,000 schoolchildren took part in a testing program. This trial was sponsored by the National Foundation for Infantile Paralysis, which had given $1,700,000 to Salk and his research workers for their polio project. The vaccine was pronounced safe and effective in April, 1955. Salk received many honors, including a citation from President Eisenhower and a Congressional gold medal for "great achievement in the field of medicine." He refused to accept any cash awards, and returned to the university to improve the vaccine.

His Early Life. Salk was born in New York City, the oldest of a garment industry worker's three sons. He helped pay for his education by working after school and by earning scholarships. He was graduated from the New York University School of Medicine in 1939. There he did research with viruses in the laboratory of Thomas Francis, Jr.

In 1942, Salk went to the University of Michigan on a research fellowship, and advanced to assistant professor of epidemiology (the science of treating epidemics). Francis had become head of the department of epidemiology at Michigan's school of public health. Salk worked with Francis to develop influenza vaccines. Later, Francis directed the evaluation of the mass tests of the Salk antipolio vaccine.

Salk went to the University of Pittsburgh School of Medicine in 1947, and became research professor of bacteriology and director of the Virus Research Laboratory. In 1955, a $25,000-a-year Chair of Preventive Medicine was created at the university, and Salk was given the new post. STANLEY E. WEDBERG

SALLUST, *SAL ust* (86-34 B.C.), was a noted Roman historian and politician. He was the first Roman to treat history as more than just a chronicle of events. Sallust's writings contain the reasons for each event, and character studies of the people involved. His works include *The Conspiracy of Catiline* and *The Jugurthine War*.

Sallust was born of a poor family, in Amiternum in central Italy. He became a friend of Julius Caesar, who named him proconsul, or governor, of Numidia, a territory in northern Africa. He made a fortune there by dishonest practices. He then returned to Rome and devoted himself to writing. THOMAS A. BRADY

SALMON, *SAM uhn,* is one of the most important food and sport fishes. Every year, people throughout the world eat millions of cans of pink or red salmon. Sport fishermen also catch millions of salmon yearly.

Most of the salmon sold comes from five species that live in the coastal waters of the North Pacific Ocean. A sixth Pacific species lives only in northern Asian waters. One species, called the Atlantic salmon, lives in the North Atlantic Ocean. This fish is actually more closely related to the trout than to the Pacific salmon.

Salmon are born in a fresh-water stream, and most of them spend part of their life in the salt water of the ocean. They then return to the fresh-water stream of their birth to *spawn* (reproduce). Pacific salmon spawn only once and die soon afterward. Atlantic salmon may swim back to the ocean after spawning and return to fresh water to spawn as many as three more times. Some salmon are *landlocked* (cut off from the ocean) in lakes and streams.

Adult salmon swim upstream at spawning time. The fish are famous for their fighting spirit. They battle rushing currents and leap across swirling rapids and over waterfalls as high as 10 feet (3 meters). When hooked, they struggle furiously to escape.

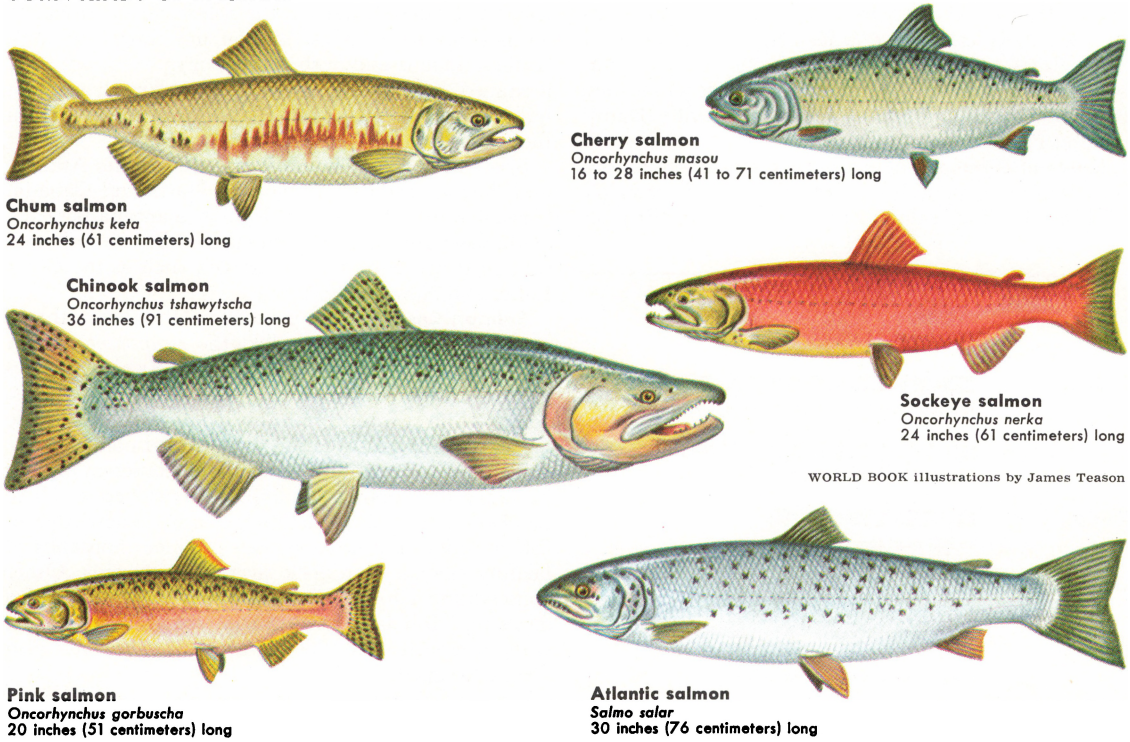
The Life of a Salmon. Most salmon spawn during the summer or autumn after swimming upstream as far as 2,000 miles (3,200 kilometers) from the ocean. The journey may take several months. Female salmon lay their eggs in the gravelly bed of a shallow, rippling stream. A male salmon stands guard as the female turns on her side and digs a saucer-shaped nest in the gravel by swishing her tail back and forth. The female lays her eggs in the nest, and the male fertilizes them with sperm. The female then swims forward a short distance, digs another nest, and lays more eggs.

The male and female may repeat the spawning process several times. The gravel dug from each nest normally washes back and covers the previously laid group

R. Thompson, APF

Salmon Swimming Upstream to lay their eggs can leap more than 10 feet (3 meters) over swirling rapids. An Atlantic salmon, above, may make this trip a number of times during its life.

SOME KINDS OF SALMON



WORLD BOOK illustrations by James Teason

of eggs. The female lays a total of 2,000 to 10,000 eggs.

The eggs hatch after three or four months, and the baby salmon lie hidden in the gravel for several weeks. They feed on a *yolk sac* (a baglike structure containing food materials) attached to their stomach. Some kinds of salmon leave fresh water for the ocean immediately after they come out of the gravel. Other species may spend up to three years in fresh water. They eat insects and small animal life called *plankton*.

Only a small percentage of the salmon reach the ocean from fresh water. Fish and birds eat some salmon, and polluted water kills others. Many die while trying to swim through huge man-made reservoirs.

Salmon that reach the ocean live there from six months to five years. During this period, they feed mainly on shrimp, squid, and small fish. Some salmon travel thousands of miles or kilometers from the mouth of the river where they were born. Yet zoologists know that most salmon return for spawning to the same stream in which they hatched. Many scientists think salmon navigate in the sea by somehow sensing the magnetic field of the earth and the currents of the ocean. After reaching the coast, the salmon apparently remember the odor of their "home" stream and follow this scent.

Salmon stop eating after reaching fresh water to spawn. They live off fat stored in their body. As the fish travel upstream, their shape and color change. For example, all male salmon develop a hooked snout. Male pink salmon grow a large hump on their back. Chum salmon of both sexes develop purple streaks on their sides, and sockeye salmon turn bright red.

Many salmon do not complete the spawning journey. Commercial and sport fishermen catch large numbers of the fish. Some salmon are killed by pollutants dumped into the rivers by industries. Artificial sloping waterfalls called *fish ladders* have been built to help salmon travel over many dams. But some salmon become so weakened by climbing the ladders that they die. See OREGON (Places to Visit [Bonneville Dam]; picture: Fish Ladders).

Kinds of Salmon. There are seven species of salmon: (1) Atlantic salmon, (2) cherry salmon, (3) chinook salmon, (4) chum salmon, (5) coho salmon, (6) pink salmon, and (7) sockeye salmon. All except Atlantic salmon live in the Pacific Ocean.

Atlantic Salmon are not nearly so plentiful as Pacific salmon and have much less commercial importance. Most Atlantic salmon measure about $2\frac{1}{2}$ feet (76 centimeters) long and weigh about 10 pounds (4.5 kilograms).

Cherry Salmon, or *masou salmon*, live in coastal waters and rivers of eastern Asia. They vary in length from about 16 to 28 inches (41 to 71 centimeters) and weigh from 5 to 23 pounds (2.3 to 10 kilograms). They are the least commercially important Pacific salmon.

Chinook Salmon, the largest species, are also known as *blackmouth*, *king*, *quinnat*, *spring*, *tule*, or *tyee salmon*. Most chinooks are about 3 feet (91 centimeters) long and weigh about 22 pounds (10 kilograms).

Chum Salmon are also called *calico*, *dog*, or *keta salmon*. They grow about 2 feet (61 centimeters) long and weigh about 10 pounds (4.5 kilograms).

Coho Salmon are also known as *medium red*, *silver*, or *silverside salmon*. They are about 2 feet (61 centimeters) long and weigh about 10 pounds (4.5 kilograms). Scientists have introduced cohos and other kinds of salmon into the Great Lakes. The salmon provide fishing and help control the number of alewives. The alewives, a species of small fish, had become a nuisance because they multiplied so rapidly (see ALEWIFE).

Pink Salmon, or *humpback salmon*, are the smallest species. These fish grow about 20 inches (51 centimeters) long and weigh about 5 pounds (2.3 kilograms).

Sockeye Salmon, also known as *blueback* or *red salmon*, are the most valuable food salmon. A sockeye measures about 2 feet (61 centimeters) long and weighs about 6 pounds (2.7 kilograms). *Kokanee salmon* are a landlocked variety of sockeye salmon.

Salmon Fishing. After salmon enter fresh water, their flesh loses flavor and color. Therefore, commercial fishermen catch salmon as the fish leave the ocean to journey upstream. Most salmon are caught in nets. Some salmon is sold fresh, frozen, or smoked, but most is canned. Salmon fishing and processing rank as major industries in Alaska, Oregon, and Washington, and in the Canadian province of British Columbia.

Sport fishing for salmon is popular on the Atlantic and Pacific coasts of the United States and Canada. Coastal waters, lakes, and rivers in many parts of the world have been stocked with salmon. But transplanted salmon thrive only in a few places, such as the Great Lakes and New Zealand.

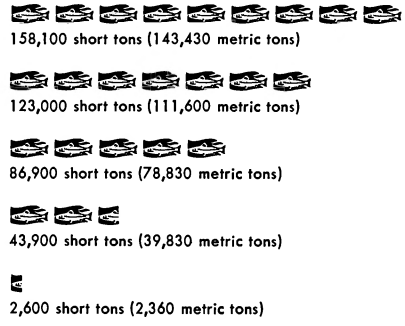
Salmon Conservation is based on the theory that a certain number of fish, called the *escapement*, should be allowed to spawn in each stream. Fishing is regulated to ensure the proper escapement. In many areas, conservation programs must overcome such man-made obstacles as dams, irrigation ditches, and pollution.

The most important advance in conservation has been the development of improved hatcheries. These hatcheries, helped by man's increasing knowledge of fish nutrition and diseases, can produce thousands of healthy salmon to restock rivers and streams. Other conservation efforts have resulted in new designs for dams and fish ladders. Artificial spawning channels, with controlled water flow and temperature, have also been developed.

Scientific Classification. Salmon are members of the salmon and trout family, *Salmonidae*. Pacific salmon are

LEADING SALMON-FISHING COUNTRIES

Tons of salmon caught in 1969



Source: *Yearbook of Fishery Statistics, 1969*, FAO

genus *Oncorhynchus*. Atlantic salmon are genus *Salmo*, species *S. salar*. JACK M. VAN HYNING

See also FISH (The Bodies of Fish; pictures: Fish Hatcheries, Fish of Temperate Fresh Waters); FISHING INDUSTRY.

SALMON, Ida. (pop. 2,910), lies at the junction of the Salmon and Lemhi rivers in the north-central part of the state. For location, see IDAHO (political map). The town serves as a supply center for a mining and grazing region. The largest cobalt deposits in the United States are located near Salmon. Mormons established a mission on the site of the town in 1855, but Indians drove them out three years later. The town was laid out in 1867. Salmon has a mayor-council form of government. WILLIAM S. GREEVER and JANET GROFF GREEVER

SALMON RIVER. See IDAHO (Rivers, Waterfalls).

SALMONELLA. See FOOD POISONING; PARATYPHOID FEVER; BACTERIA (Harmful Bacteria).

SALOL, *SAL ohl*, is a white crystalline powder composed of salicylic acid and phenol. Salol is used in medicine as an antiseptic.

SALOME, *suh LO mee*, is the Biblical character who is said to have caused the beheading of John the Baptist. She was the daughter of Herodias and the stepdaughter of Herod Antipas, governor of Galilee and Peraea.

According to the Biblical story, Salome danced at a birthday party for Herod. He was so pleased by her performance that he offered to grant Salome any request she might make. At her mother's suggestion, Salome requested the head of John the Baptist. Herod ordered John beheaded, and sent the head to her on a platter.

Another Salome appears in the Bible as one of the holy women present at the Crucifixion of Christ and later at the Resurrection of Christ. This Salome was the wife of Zebedee and the mother of the apostles James and John. FREDERICK C. GRANT

See also HEROD (Antipas); JOHN THE BAPTIST; OPERA (The 1900's; The Opera Repertoire); STRAUSS, RICHARD.

SALOMON, HAYM (1740?-1785), was an American banker and patriot. He was born into a Jewish family in Lissa, Poland, and he came to New York in 1772 after taking part in a struggle for Polish independence. The British government arrested him as a spy in 1776 and again in 1778, at which time he was sentenced to die. Salomon escaped to the American lines by bribing his jailer. Later, he operated a brokerage firm in Philadelphia that aided Robert Morris, the Revolutionary War financier. CLARENCE L. VER STEEG

SALON, *sah LAWN*, is a drawing room or reception room, and also a reception held in the room. This French word became fashionable when the French kings showed their art treasures in the reception room of the Palace of the Louvre.

Art exhibitions are called salons. Three famous Paris salons include the Salon de la Société Nationale des Beaux Arts, the Salon d'Automne, and the Salon des Indépendants. Important art movements, such as postimpressionism, symbolism, and cubism, were introduced in the Salon des Indépendants; and the works of Paul Gauguin, Georges Seurat, and Paul Cézanne were first shown to the public there.

The word *salon* is also used for a gathering of people famous in the arts and for their wit. SIBYL MOHOLY-NAGY

SALONIKA, *SAL oh NEE kuh*, or *suh LAHN ih kuh*, or, in Greek, THESSALONIKI, *THAY sah law NYEE kye* (pop. 250,920; met. area 378,444), is a port on the Gulf of Salonika in Greece. For location, see GREECE (map). Until 1912, Salonika was a Turkish city. Its broad streets are paved with lava. Slender *minarets* (towers of Moslem houses of worship) rise above the city.

Salonika is a leading industrial center and has an up-to-date business section. Its industries include foundries, shipyards, flour mills, and textile mills that manufacture cotton, woolen, and silken goods. The city also produces tobacco, soap, and leather goods. The port of Salonika, opened in 1901, is a major Balkan outlet to the Aegean Sea. Chief exports are tobacco, hides, and manganese and chromium ores. It has been a free trade zone for goods shipped to Yugoslavia since 1914.

In ancient times, the city was called THERMA because of its nearby hot springs. Cassander, king of Macedon, re-established the town in 315 B.C. and named it after his wife. The city of Salonika has been fought over and ruled by almost every neighboring country. The Saracens invaded it in A.D. 904, and sold 22,000 of its people into slavery (see SARACEN). From 1413 until 1912, the city belonged to the Ottoman (Turkish) Empire. Salonika fell to Greece in 1912 in the first Balkan War.

During World War I, the Allies used Salonika as a base for campaigns. Fierce fighting destroyed the business section in 1917, but the area was rebuilt. The Germans occupied Salonika from 1941 to 1944 during World War II, and it suffered considerable damage. Greek patriots freed the city in October, 1944. The city's industries have expanded since the war and new factories have been built. HARRY N. HOWARD

SALPIGLOSSIS. See PAINTED-TONGUE.

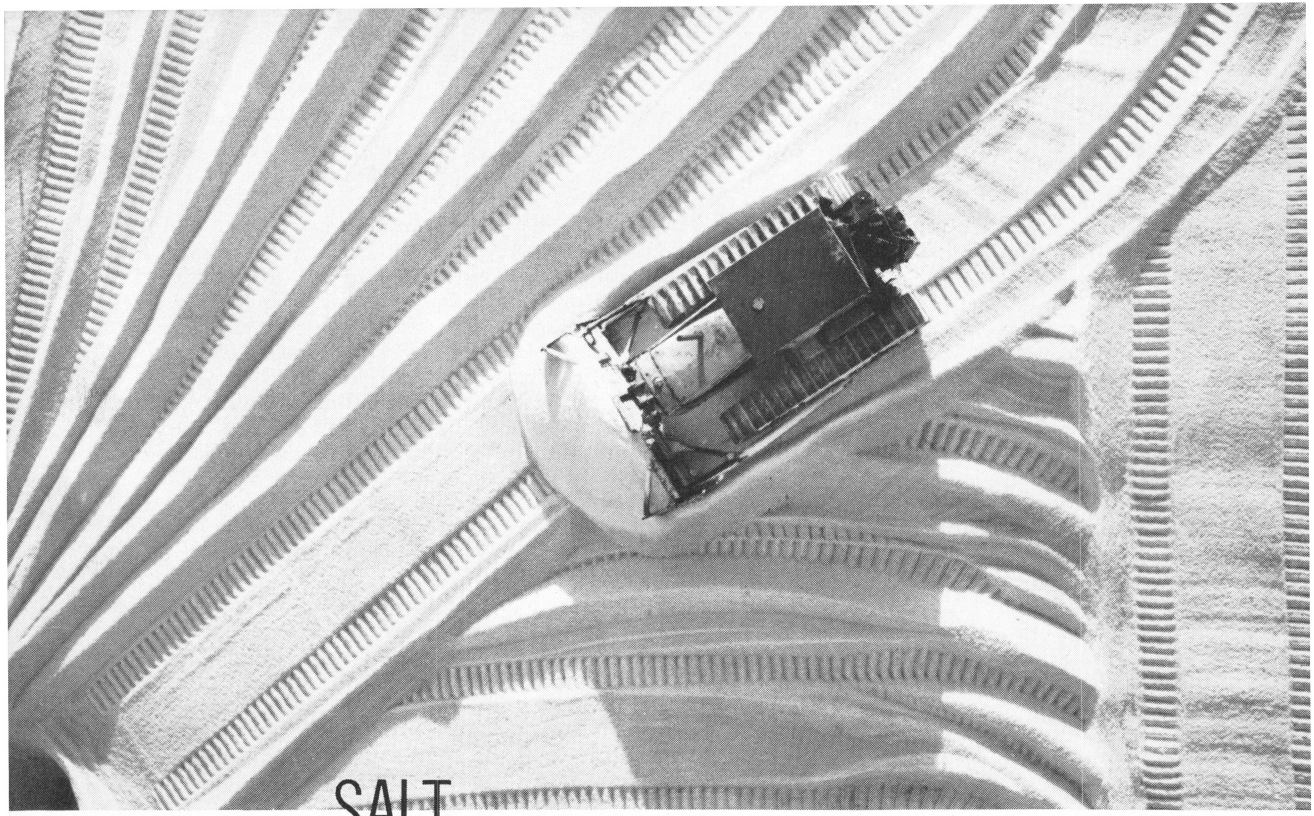
SALSIFY, *SAL suh fih*, is a biennial garden vegetable. It is also called OYSTER PLANT because its fleshy root has an oyster-like flavor. The plant is native to the Mediterranean area, but it also grows in the northern United States. The tapering roots are used in Europe and America as a table vegetable. A common method of preparation consists in cutting them into small pieces, boiling until tender, and creaming. They are also good boiled, then dipped in cracker crumbs and fried. They give an agreeable flavor to soups. Farmers cultivate salsify in the same manner as the parsnip. The roots are easily kept over winter, either in the ground or stored in cool, moist earth.

Salsify Roots acquire a decided oyster flavor after a heavy frost. As a result, this healthful garden vegetable is often called *oyster plant*.
J. Horace McFarland

Scientific Classification. The oyster plant belongs to the composite family, *Compositae*. It is classified as genus *Tragopogon*, species *T. porrifolius*. JOHN H. MACGILLIVRAY

See also PARSNIP.

SALT



Caterpillar Tractor Co.

Bulldozers Move Salt from Huge Stockpiles to Railroad Cars.

SALT (chemical formula NaCl) is a mineral that is found both in solid and liquid form. The liquid is called brine. Salt contains two elements, chlorine and sodium, and is known chemically as *sodium chloride*. Mineralogists call salt that is found in mines *halite*.

Dry salt is made up of tiny cubelike crystals that can be seen under a microscope. These crystals will not absorb water readily. But often tiny amounts of other minerals become mixed with the salt. These take up water from the air quickly, and sometimes, on rainy days, the salt in the salt shaker becomes moist and lumpy.

Salt is essential to health. Body cells must have salt in order to live and work. Blood, sweat, and tears are salty. Salt makes up about 0.9 per cent of the blood and body cells. When doctors inject medicines into the blood or tissues, they often mix them with a *physiological salt solution* that is composed of sterile water and 0.9 per cent salt.

How Salt Is Used

It has been estimated that there are more than 14,000 uses for salt. Most people think of salt chiefly as a seasoning for food. But less than 5 per cent of the salt produced in the world each year is used in this way. Salt and its by-products are used by meat packers, chemical companies, hide and leather processors, and food processors, such as manufacturers of dairy products. Much salt is used to make soda ash, a compound used in making glass, soap, and washing compounds.

Caustic soda, chlorine, and chlorine products are derived from salt that has been broken down by electricity. This process, known as *electrolysis*, consists of passing an electric current through a salt solution (see ELECTROLYSIS). The caustic soda, or lye, obtained by this process is used to make soap, paper, and rayon, and to purify petroleum. The chlorine is used to make paper white and to purify water. See CHLORINE.

Farmers feed salt to livestock and use it as a preservative for hay in storage. Factories, plants, laundries, and other industrial institutions use salt to soften water and condition it. Salt is also used to hold firm the materials used in building secondary roads. It is also used in heat-treating, smelting, and refining metals.

When salt is mixed with snow or ice, it forms a solution with a lower freezing point than that of water. That is why salt melts snow and ice. Therefore, it is used to freeze ice cream and is used in cooling refrigerator cars on railroads (see REFRIGERATION [Ice]). Railroads also use salt to control the formation of ice around railroad switches and crossings.

Salt has *antiseptic* (germ-killing) properties that make it useful as a mouthwash or gargle. It may also be used for cleaning teeth.

Where Salt Comes From

Salt from the Sea. There is a little more than $\frac{1}{4}$ pound of salt in each gallon (or 30 grams in each liter) of sea water. It has been estimated that if all the oceans dried up, they would leave about 4,419,300 cubic miles (18,420,400 cubic kilometers) of rock salt. That would be enough to cover all the United States except Alaska and Hawaii with a layer of salt more than $1\frac{1}{2}$ miles (2.4 kilometers) deep. Among the larger seas, the Mediterranean and Caribbean seas contain the greatest amounts of salt. The Dead Sea, the Red Sea, and Great Salt Lake contain even larger amounts of salt. Seas and

lakes are salty because as streams and rivers flow over the land, they dissolve the salt from the soil and rocks, and carry it to the large bodies of water. Here, the fresh water evaporates and leaves salt solutions that become more and more concentrated.

Salt was first taken from the sea by scooping out shallow holes along the seashore. Waves, breaking along the shore, filled the holes with brine. The sun and wind caused the water in the brine to evaporate, leaving behind the crude salt. This process was known as the *solar* (sun) method. The solar method is still used. But, to speed the process of evaporation, the brine is put in enormous iron pans placed over extremely hot fires.

Salt obtained in this manner is very pure. But it has been estimated that a single salt plant should contain at least 5,000 acres (2,000 hectares) of land to make the solar system practical. This would not be possible in areas where land is limited and highly valued. There are great solar plants in the United States in the San Francisco Bay area and around Great Salt Lake.

Salt from Mines. Salt is found beneath the ground in almost every part of the world. Sometimes the salt lies near the surface or even above it. Rocks of salt that appear above the ground are called *salt licks*. However, most salt veins lie far beneath the earth's surface and the salt must be mined in much the same way that coal is mined. Shafts are sunk and elevators are installed in them. The miners descend, and by means of compressed air drills and electric crushing and shoveling machines, break loose the *halite* (rock salt). The salt is taken by elevators to the top of a *tippler*, a building that may be eight stories high. On its way down through the building, it goes through crushers, passes over screens that separate it into crystals of various sizes, and is put in sacks or bulk carloads. These are shipped to consumers.

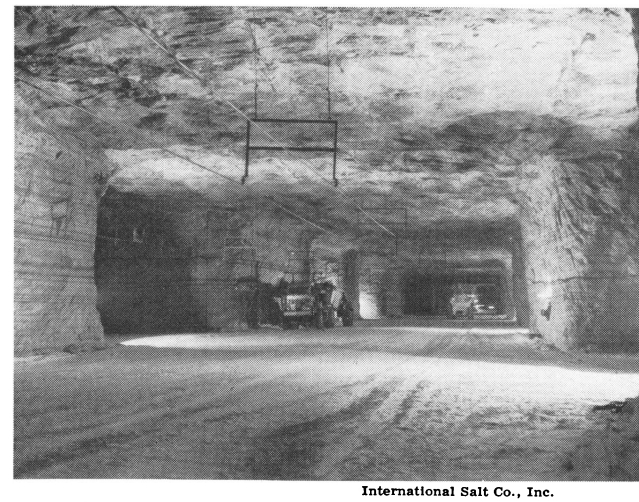
Salt from Wells. Much of the salt produced in the United States comes from salt wells. This salt is dissolved by water and pumped to the surface. A salt well is drilled in much the same way that a water or oil well is drilled. The salt well has a double pipe, or *casing*, sunk into it. One pipe is inside the other, leaving space between the two. Pure, fresh water is pumped down through this space to the salt vein below. It forms a solution of salt and water, which is heavier than pure water. The brine sinks to the bottom of the well. The solution is then forced up the inner pipe by the pressure of the fresh water that continues to come down. When a vein of salt lies very deep, air pressure forces the brine to the surface. The brine that comes from the well contains only the impurities that dissolve in water. Solid impurities are left at the bottom of the well. The brine is refined in about the same manner as sea salt.

Salt Production

The United States produces over 44 million short tons (40 million metric tons) of salt each year. More than 12 per cent is taken from the sea, over 29 per cent from mines, and about 57 per cent from wells. Louisiana, Texas, Ohio, New York, and Michigan produce large amounts. Salt is also produced in California, West Virginia, and Kansas. In Canada, the province of Ontario is an important salt-producing area. There, salt is taken from the brines of a huge underground salt basin, one that ranges up to about 3,000 square miles (7,800 square kilometers) in area.

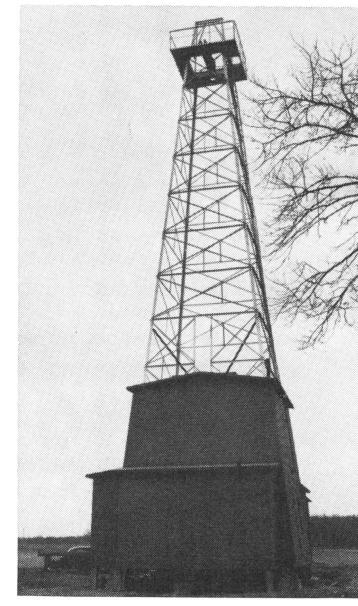
United Press Int.

Salt from the Sea is gathered into mounds to be dried by the sun. The Goajiro Indians of Colombia gather the salt.



International Salt Co., Inc.

A Salt Mine about 1,000 feet (300 meters) below the surface of Detroit produces over 1 million short tons (910,000 metric tons) of salt a year. Mining machinery hollows out rooms of salt.

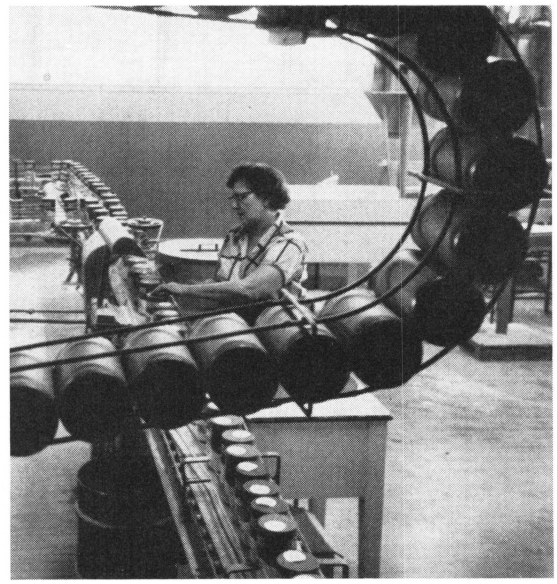


Salt Wells, dug from derricks like those in oil fields, account for much of the total amount of salt produced in the United States. The brine must be refined to remove any impurities that dissolve in water.

General Foods Corp.

Friends Magazine

Harvesting Machines in a Man-Made Salt Bed scoop up the loosened mineral, which has crystallized from water taken from Great Salt Lake. The crude salt then goes to a refining plant.



Friends Magazine

Cans of Table Salt move along the assembly line in the packaging room. Workers examine each can before it goes to the shipping department.

The leading salt-producing countries in Europe are Russia, Great Britain, and West Germany. Some of the largest and most unusual salt mines in the world are located at Wieliczka, Poland, 8 miles (13 kilometers) from Kraków. There, salt veins are 900 feet (270 meters) below the earth's surface. During the hundreds of years that the mines have been worked, miners have carved statues and altars out of the pure salt crystals. The sculptures and underground rooms cut out of solid salt have become a famous tourist attraction.

History

An early written reference to salt occurs in the Bible. The Book of Job, written about 300 years before the

LEADING SALT-PRODUCING STATES AND PROVINCES

Tons of salt produced in 1969

Louisiana	12,435,000 short tons (11,280,800 metric tons)
Texas	9,261,000 short tons (8,401,400 metric tons)
Ohio	5,844,000 short tons (5,301,600 metric tons)
New York	5,582,000 short tons (5,063,900 metric tons)
Michigan	4,819,000 short tons (4,371,700 metric tons)
Ontario	3,560,000 short tons (3,230,000 metric tons)
California	1,895,000 short tons (1,719,100 metric tons)
West Virginia	1,309,000 short tons (1,187,500 metric tons)
Kansas	1,270,000 short tons (1,152,000 metric tons)

Sources: Statistics Canada; U.S. Bureau of Mines

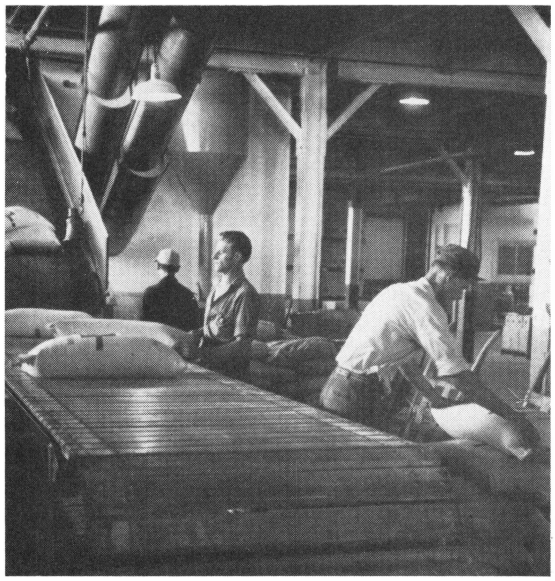
LEADING SALT-PRODUCING COUNTRIES

Tons of salt produced in 1969

United States	44,245,000 short tons (40,138,400 metric tons)
China	*16,500,000 short tons (14,970,000 metric tons)
Russia	*12,677,000 short tons (11,500,400 metric tons)
Great Britain	9,484,000 short tons (8,603,700 metric tons)
Germany (West)	9,213,000 short tons (8,357,900 metric tons)
India	7,033,000 short tons (6,380,200 metric tons)
France	*5,346,000 short tons (4,849,800 metric tons)
Italy	4,345,000 short tons (3,941,700 metric tons)
Canada	4,247,000 short tons (3,852,800 metric tons)
Mexico	*3,307,000 short tons (3,000,100 metric tons)

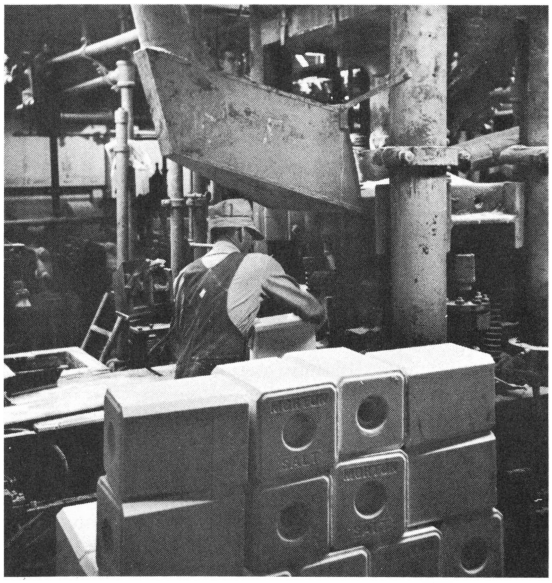
*Estimate

Source: U.S. Bureau of Mines



Friends Magazine

Packaged Salt comes in many different weights, sizes, and forms. Coming down a conveyor belt, *above*, are 50- and 100-pound (23- and 45-kilogram) bags of salt.



Friends Magazine

Salt Has Many Uses in farming, the home, and industry. A worker stacks salt, *above*, that has been pressed into blocks to feed livestock.

birth of Christ, says, "Can an unsavory thing be eaten, that is not seasoned with salt?" The Bible mentions salt more than 30 times.

Salt at one time had religious significance, and was a symbol of purity. Among the Hebrews, it was a religious custom to rub newborn babies with salt to ensure their good health. Among many peoples, salt is still used as a sign of honor, friendship, and hospitality. The Arabs say "there is salt between us," meaning "we have eaten together, and are friends."

Salt was a chief economic product of the ancient world. It was important in the development of the earliest highways of trade. Roman soldiers built the *Via Salaria* (Salt Road), one of the great military roads in history, from the saltworks at Ostia to Rome.

Salt was once so scarce and precious that it was used as money. Caesar's soldiers received part of their pay in common salt. This part of their pay was known as their *salarium*, and it is from this that the word *salary* comes. Also dating back to the days when workers were paid either all or part of their wages in salt, is the modern expression "not worth his salt." It literally meant that a man did not earn his wages. DANIEL PETERKIN, JR.

See also COLOMBIA (picture: Goajiro Indian Women); GREAT SALT LAKE; SALT, CHEMICAL; CHINA (picture: Salt Recovered from the Yellow Sea).

SALT, talks. See STRATEGIC ARMS LIMITATION TALKS.

SALT, CHEMICAL, is a compound that results when a base neutralizes an acid. For example, ordinary table salt, *sodium chloride*, is formed when the base sodium hydroxide neutralizes hydrochloric acid. The salt *calcium carbonate* is formed when the base calcium hydroxide neutralizes carbonic acid. See NEUTRALIZATION.

Salts are among the most important chemical compounds. They are used in making many industrial and agricultural chemicals. For example, sodium chloride is used in making sodium hydroxide, a chemical needed in making rayon, soap, and many other products. The salt ammonium nitrate is used in fertilizers to add nitrogen to soil. Some metals, including sodium and potassium, are extracted from salts. Plants and animals need various salts in order to stay healthy. For example, the salts sodium chloride and potassium chloride supply *ions* (electrically charged atoms) needed by nerve cells.

The earth's crust contains many salts. The most abundant salt, sodium chloride, is found in large land deposits and in the ocean. The salt calcium carbonate is found in limestone and in the shells of sea animals. Well-known natural salt deposits include Great Salt Lake in Utah, beds of borax in Nevada, and large salt beds near Stassfurt, Germany.

The salt formed when a base completely neutralizes an acid is called a *normal salt*. Sodium sulfate (Na_2SO_4) is a normal salt. Incomplete neutralization may produce either an *acid salt* or a *basic salt*. These salts act like acids or bases as well as like salts. Acid salts contain hydrogen ions, as in sodium bisulfate ($NaHSO_4$). Basic salts contain hydroxyl radicals, as in basic bismuth chloride ($Bi[OH]Cl_2$ or $Bi[OH]_2Cl$).

A salt crystal contains positive and negative ions in a regular, repeating arrangement. This arrangement is called an *ionic lattice*. When the salt crystal dissolves in water, these ions are released and move about freely in the solution. ESMARCH S. GILREATH

Related Articles in WORLD BOOK include:

Acetate	Chloride	Nitrate	Sulfate
Carbonate	Halogen	Nitrite	Sulfide

SALT LAKE. See GREAT SALT LAKE.

SALT LAKE CITY (pop. 175,885; met. area 705,458) is the capital and largest city of Utah. The Church of Jesus Christ of Latter-day Saints, commonly called the Mormon Church, has its world headquarters there. Its members are known as Mormons. They form about two-thirds of the city's population. Salt Lake City is one of the chief centers of culture, finance, industry, and transportation of the Rocky Mountain States.

Salt Lake City lies in the Salt Lake Valley at the foot of the Wasatch Range of the Rocky Mountains. It is about 15 miles (24 kilometers) southeast of Great Salt Lake. For location, see UTAH (political map).

Mormon pioneers fleeing from religious persecution in Illinois founded Salt Lake City on July 24, 1847. When their leader, Brigham Young, saw the scenic land, he declared: "This is the place. Drive on." Young was referring to the site he had seen in a vision. The Mormons named the city for Great Salt Lake.

The City occupies 70 square miles (181 square kilometers) and is the county seat of Salt Lake County. Salt Lake City and nearby Ogden form the center of a metropolitan area that covers Davis, Salt Lake, Tooele, and Weber counties. About two-thirds of Utah's people live in this 9,409-square-mile (24,369-square-kilometer) area.

The Mormon Temple, with its majestic six spires, stands in Temple Square in the heart of downtown Salt Lake City. The Mormon Tabernacle, famous for its huge organ with 11,000 pipes, is next to the temple. The 28-story Mormon Church Office Building, the tallest building in Utah, rises in the center of the downtown area. Nearby are the Salt Palace, a convention and civic center; and the Sea Gull Monument. Pioneers erected this monument to honor sea gulls that ate crop-destroying grasshoppers during the summer of 1848.

The state Capitol stands at the northern edge of the city. A dome 285 feet (87 meters) high towers over the building. The "This Is The Place" Monument in Pioneer Trails State Park marks the place where Young and his party first entered the Salt Lake Valley.

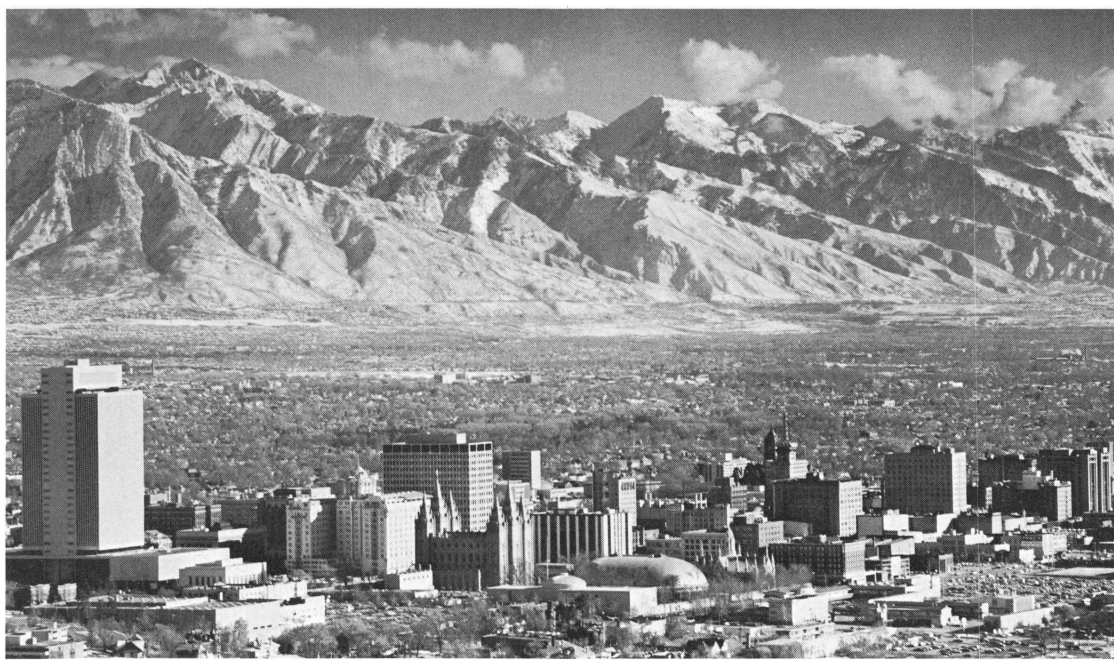
About 95 per cent of Salt Lake City's people were born in the United States. Persons of English and German ancestry form the largest groups in the city.

Economy. The Salt Lake City metropolitan area has about 700 manufacturing plants. Its leading industries make chemicals, electronics, food products, metal products, petroleum, and steel.

The city owes much of its industrial importance to the rich natural resources in the area. For example, the largest open-pit copper mine in North America operates in nearby Bingham Canyon. This mine supplies nearly a fifth of the nation's copper. Chemical plants take large amounts of chlorides, magnesium, and potash from Great Salt Lake. Many ski slopes and camping areas in the Wasatch Range help make tourism an important industry in Salt Lake City. State and federal government agencies rank among the chief employers in the city. Salt Lake City also ranks as an important banking center.

Passenger trains and four rail freight lines serve the city. Six airlines use Salt Lake City International Airport. Salt Lake City has 2 daily newspapers, the *Deseret News* and the *Tribune*, and 4 television stations and about 20 radio stations.

Education and Cultural Life. The Salt Lake City School District consists of about 40 elementary schools



Salt Lake Area Chamber of Commerce

Salt Lake City, the capital and largest city of Utah, lies at the foot of the snow-covered Wasatch Range. Mormons, led by Brigham Young, settled in the area in 1847.

and 4 high schools. The city has 2 private schools and 10 church-supported schools. The University of Utah and Westminster College are in Salt Lake City.

The city is the home of Ballet West, a dance company; the Mormon Tabernacle Choir; and the Utah Symphony Orchestra. Other cultural attractions include the Hansen Planetarium, the Hogle Zoo, the Salt Lake Art Center, the Utah Museum of Fine Arts, and the Utah Museum of Natural History. The Salt Lake City Park District has 25 parks and 6 public golf courses, which cover a total of about 2,200 acres (890 hectares). The International Peace Gardens in Jordan Park feature the national flowers of about 15 countries. The Utah Stars of the American Basketball Association play their home games in the Salt Palace.

Government. Salt Lake City has a commission form of government. The voters elect a mayor and four commissioners to four-year terms. Each of these officials administers one of the city government's five departments. Property taxes provide most of the city's income.

History. Indians of the Paiute, Shoshoni, and Ute tribes lived in the Salt Lake Valley before white men first arrived. James Bridger and other noted American fur trappers visited the region in 1824. In 1847, a group of 148 Mormons led by Brigham Young established a settlement they named Great Salt Lake City. By 1850, about 5,000 Mormons had settled in the community. Congress established the Utah Territory that year, and Young became its first governor. Great Salt Lake City was incorporated as a city in 1851 and became the territorial capital in 1856.

The discovery of lead and silver in Bingham Canyon in 1863 led to the development of mining in the Salt Lake City area. Great Salt Lake City changed its name to Salt Lake City in 1868. In 1869, at nearby Promontory, workers laid the tracks that completed the nation's first transcontinental railroad system. The rail service boosted the economy of the Salt Lake City area by opening new markets for its farm and mining products. Utah became a state in 1896, with Salt Lake City as the capital.

The mining of copper, lead, and silver boomed in Bingham Canyon during the late 1800's and early 1900's. Mining companies built large smelters to refine the rich ores, and Salt Lake City prospered and grew rapidly. Between 1900 and 1930, the city's population increased from 53,531 to 140,267. The demand for metals during World War II (1939-1945) brought new prosperity to Salt Lake City's mining industry. Industrial expansion continued after the war and helped the city's population reach 189,454 by 1960.

The population dropped during the 1960's, partly because of a trend toward suburban living. The Mormon Church acted to help reverse this trend by building a $40-million downtown shopping mall with more than 50 stores. The project was scheduled for completion in the mid-1970's. Salt Lake City also faces the challenge of preserving its scenic and recreational attractions while encouraging industrial growth. WILLIAM B. SMART

For the monthly weather in Salt Lake City, see UTAH (Climate). See also MORMONS; UTAH (pictures); YOUNG, BRIGHAM.

SALT LICK. See SALT (Salt from Mines).

SALT RIVER is a stream in south-central Arizona formed by the joining of the White and the Black rivers in Gila County. From there, the Salt River flows west for 200 miles (320 kilometers) and empties into the Gila River near Phoenix (see ARIZONA [physical map]). The Salt River Valley is irrigated by five dams, which form a series of artificial lakes extending for 60 miles (97 kilometers) along the Salt River.

SALT SEA. See DEAD SEA.

SALT SPRINGS DAM ranks among the highest rock-fill type dams in the United States. It makes up part of a power project on the North Fork of the Mokelumne River in central California. The dam, completed in 1931, is 328 feet (100 meters) high and 1,300 feet (396 meters) long. It contains about 3 million cubic yards (2.3 million cubic meters) of rock-fill. Its power plant has a 44,000-kilowatt capacity. T. W. MERMEL

SALT-WATER FISH. See FISH (Where Fish Live; pictures).

SALTBUSH. See AUSTRALIA (Plants).

SALTEN, FELIX (1869-1945), was an Austrian author best known for his children's novel *Bambi* (1923). The story describes the adventures of a young deer growing up in a forest. Walt Disney based his animated motion picture *Bambi* (1942) on the book. In addition to several other children's books, Salten also wrote drama criticism, novels, and plays.

Salten was born in Budapest, Hungary. His real name was Siegmund Salzman. He spent most of his life in Vienna but fled to Switzerland in 1938 after the Nazis took control of Austria. CHARLEMAE ROLLINS

SALTER, SUSANNA MADORA (1860-1961), was the first woman mayor in the United States. She was elected mayor of Argonia, Kans., in 1887 and served for one year. Persons who opposed Prohibition put her name on the ballot as a joke. They thought Salter would lose. She was a Woman's Christian Temperance Union officer who favored Prohibition. Salter was born in Lamira, Ohio. H. E. SOCOLOFSKY

SALTO, *SAHL toh* (pop. 57,714), is the second largest city in Uruguay. It is located 60 miles (97 kilometers) north of Paysandú (see URUGUAY [color map]). The city provides an important trading center for the farmers and ranchers of northern Uruguay. Salto is sometimes called the *City of Oranges* because of its large orange and tangerine groves. JOHN TATE LANNING

SALTON SEA, *SAWL t'n,* is a shallow, saline lake in southeastern California. It is about 30 miles (48 kilometers) long and from 8 to 10 miles (13 to 16 kilometers) wide. Its surface is about 232 feet (71 meters) below sea level. The lake lies chiefly in Imperial County between the Santa Rosa and Chocolate mountains. It is about 80 miles (130 kilometers) northeast of San Diego. Salton Sea shares an arid trough with the Imperial and Coachella valleys. The trough has been shut off from the Gulf of Lower California by sediment deposited by the Colorado River. Until 1905, the valley area was a salt-covered depression. Between 1905 and 1907, the Colorado broke through irrigation head gates and flowed into the Salton Basin to form the Salton Sea. The lake covered about 450 square miles (1,165 square kilometers). But when the floodwaters were halted, much of the lake evaporated. C. LANGDON WHITE

SALTONSTALL, LEVERETT (1892-), served as U.S. senator from Massachusetts from 1945 to 1967. He was elected to serve out the unexpired term of Henry Cabot Lodge, Jr., who resigned to enter the army. A Republican, Saltonstall served in the state house of representatives from 1923 to 1936. He became governor of Massachusetts in 1939 and served three consecutive terms. He was born in Chestnut Hill, Mass.

SALTPETER, also called NITER, is a mineral known to chemists as *potassium nitrate*. It occurs in limestone caves when decaying animal and plant materials *oxidize* (combine with oxygen). Industry uses saltpeter to prepare matches, explosives, and fertilizers. Chemists use it as a reagent in analytical chemistry. It is also used as an oxidizer in liquid rocket fuel propellants.

Saltpeter occurs as colorless or white crystals or crystalline powder that has a cool salty taste. It dissolves readily in water and melts at about 337° C (639° F.). Saltpeter has the chemical formula, KNO_3. Industry manufactures it by reacting potassium chloride with either sodium nitrate or nitric acid.

The name *saltpeter* also refers to two other chemicals. *Chile saltpeter* is impure sodium nitrate ($NaNO_3$). It is used much like potassium nitrate. Purified Chile saltpeter forms white crystals that melt at 308° C (586° F.). *Lime saltpeter*, or *Norwegian saltpeter*, is calcium nitrate ($CaNO_3$). This chemical is a white solid used to make matches, explosives, and other chemicals.

SALTS are saline laxatives. Some common salts include *Epsom salt* (magnesium sulfate), *Glauber's salt* (sodium sulfate), and *Rochelle salt* (sodium and potassium tartrate). Salts act in the intestines by causing water to accumulate and move waste materials. Salts are valuable when used carefully at the correct time, but excessive use may irritate the intestines. See also EPSOM SALT; GLAUBER'S SALT; SEIDLITZ POWDERS.

LOUIS D. BOSHES

SALUDA DAM, *suh LOO duh*, is among the 30 largest earth-fill dams in the United States. It is part of a hydroelectric power project on the Saluda River, 10 miles (16 kilometers) upstream from Columbia, S.C. Saluda Dam is 211 feet (64 meters) high and 8,650 feet (2,637 meters) long at the top. It contains 11 million cubic yards (8.4 million cubic meters) of earth. The dam was completed in 1930 at a cost of $6 million.

T. W. MERMEL

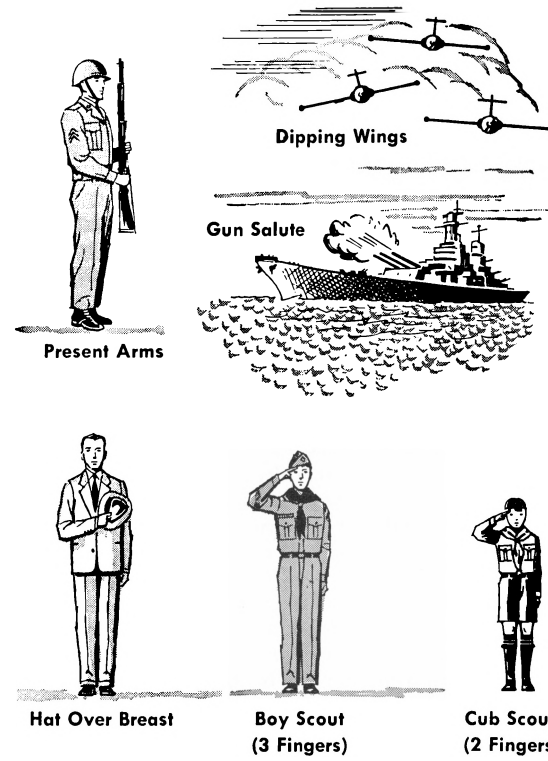
SALUKI, *suh LOO kee*, or GAZELLE HOUND, is believed to be the oldest purebred dog in the world. It was developed in the Middle East as early as 4000 B.C. One of the swiftest dogs, the Saluki was once teamed with hawks for hunting gazelles. The hawk struck the prey and the Saluki held it down until the hunters arrived. The Saluki resembles the greyhound. It has a smooth, soft coat, with fringes of long hairs on its ears, legs, and thighs. It is 23 to 28 inches (58 to 71 centimeters) high at the shoulder and weighs about 60 pounds (27 kilograms).

OLGA DAKAN

See also DOG (picture: Hounds).

SALUTE, *suh LYOOT*, is a gesture of greeting, courtesy, or recognition, such as a handshake. In the armed forces, the military salute shows respect to an officer.

Military Hand Salutes. According to U.S. Army regulations, a man must use the hand salute at a distance of not more than 30 paces and not less than six paces. He raises his right hand snappily to his forehead, with his palm down and his index finger at the peak of his cap. He holds his forearm at a 45° angle. Soldiers must look directly at the officer when saluting, and he must return the salute if possible. Soldiers must salute, whether or



WORLD BOOK photo

All the U.S. Armed Forces Use the Same Salute, as shown by the WAF, WAC, and WAVE above. Sentries salute by presenting arms. Fliers salute by dipping the wings of their planes. Warships fire a gun salute to greet the President and other important visitors. The number of rounds fired depends on the dignitary's rank. The President receives a 21-gun salute.

U.S. Army Photograph

United States

Canadian Forces Photo

Canada

British Information Service

Great Britain

Sovfoto

Poland

not they are wearing any head covering. Navy men must be wearing head covering when they salute. Aboard ship, sailors salute an officer only at the first meeting during the day, except when reporting in the course of duty. Officers and enlisted men salute the flag and officer of the deck when boarding or leaving their ship.

Men in uniform must stand at attention and salute while the national anthem is played and while the flag is raised or lowered. They must also salute when they pass the flag or the flag passes them in a parade. A man who is running should slow to a walk before saluting. Only men in good standing may salute. A prisoner may not salute.

Salutes with Weapons. Soldiers in formation carrying rifles *present arms* to officers. A man does this by holding the rifle vertically in front of himself, with the trigger forward. Standing sentinels also present arms. Marching soldiers, in formation or singly, give the *rifle salute* by raising their left forearms, with wrists and fingers in a straight line, and touching their rifles at a point just behind the rear sight.

In Other Countries, military salutes are similar to those of the United States. British servicemen salute with their palms out, rather than down. Some dictatorships adopted special salutes that all persons had to use. In Fascist Italy and Nazi Germany, civilians and soldiers saluted by holding their right arms out at an angle, palms down. Russian and Spanish soldiers and civilians often used a clenched-fist salute with their right arms. Such salutes were often adopted by political parties for their members.

Planes and Ships also exchange salutes. Fliers often dip, or tilt, the wings of their planes. Ships passing on the high seas salute by dipping their flags once. Merchant ships in port outside their own country raise the national flag of the country they are visiting as a salute.

Other Salutes. Cannon, drum flourishes, and music are often used to salute visiting dignitaries. The number of rounds fired depends on the importance of the visitor. When a head of state visits a country, armed forces usually give a 21-gun salute, four ruffles and flourishes on the drums, and the visitor's national anthem. Other salutes may be given with as few as five guns. Warships have similar salutes. CHARLES B. MACDONALD

See also FLAG (Saluting the Flag).

SALVADOR, *SAHL vuh DAWR,* also called BAHIA, *buh EE uh* (pop. 1,017,591; met. area 1,095,274), is one of the largest cities in Brazil. Founded in 1549, it is the oldest city in Brazil, though some smaller towns are older. From 1549 to 1763, Salvador was the capital of the Portuguese colony of Brazil. Salvador is an Atlantic port on the Bay of All Saints, about 800 miles (1,300 kilometers) northeast of Rio de Janeiro. For location, see BRAZIL (political map). The lower part of the city lies along the bay, and the upper part stands on the bluffs overlooking the bay. Roads and hydraulic elevators connect the two sections of the city.

Salvador has large cotton factories, and exports sugar, cotton, hides, tobacco, and cacao. Bahia cigars and chocolate are famous. The city has many monumental buildings of the past. There are several cultural institutions, including the state and Roman Catholic universities, a gallery of art, and a Foundation for the Development of Science in Bahia. Salvador's medical school is the oldest in Brazil. The Prince Regent of Portugal (later King John VI) founded the school in 1808. MANOEL CARDOZO

SALVADOR, EL. See EL SALVADOR.

SALVAGE, *SAL vij,* is money or goods paid to those who save ships or cargo abandoned at sea. Help which is given to a vessel in distress or danger is called *salvage service.* In Great Britain, salvage is granted only for acts on the high seas. In the United States, courts allow salvage for saving goods, ships, and life on inland waters as well as on the high seas.

The *salvor* is a person who helps to save a ship other than the one on which he sails. A salvor cannot collect salvage for helping to save his own ship. Salvage can be collected only for saving a ship that sails under its own power, or a moving barge. It is not granted in the case of a barge or other floating structure moored to a shore or dock. The danger from which a ship is salvaged must be real, not something which might happen. The ship saved must be brought to a safe place, ready to be returned to its owner for repair.

Some countries have fixed by law the amounts to be paid in salvage cases. The United States and Great Britain have no such laws. American and British courts grant salvage claims based on conditions under which the act has been performed. It is usual to pay amounts substantially more than those generally paid to seamen for regular work.

Division of salvage among the salvors also rests on the decision of the courts. The master's share is usually double that of the mate. The mate's share is usually double that of a seaman. The share of the men who do the work and sail the salvaged ship back to port is usually double that of those who remain aboard the salvor vessel. The greatest amount that was ever recovered from a sunken ship was the $24,793,540 brought up from the British liner *Laurentic.* The liner had been sunk by a German torpedo off the coast of Northern Ireland in 1917.

The term *salvage* is also used to describe goods recovered from emergencies on land, such as floods or fires. Critically reviewed by TELFORD TAYLOR

See also DIVING, UNDERWATER; FLOTSAM, JETSAM, AND LAGAN.

SALVARSAN. See EHRLICH, PAUL.

SALVATION ARMY, THE, is a world-wide Christian religious body with semimilitary structure. It provides food, shelter, and clothing to the needy, and administers to the spirit by bringing religion to many whom churches never reach.

Services and Activities. The Salvation Army maintains hospitals for unwed mothers, industrial homes where men rebuild their characters, low-cost lodging-houses, and nurseries for babies of working mothers. It also maintains fresh-air camps, boys' clubs, family welfare-work programs, and provides aid to prisoners and their families.

A distinctive feature of the army is its street-corner musicians, who play, sing, and preach the glory of God. Indoor religious meetings usually follow. In country after country, this method of spreading the Gospel has succeeded in winning converts.

The Salvation Army has over 26,000 officers, both men and women. During World War I, its mobile canteens were welcome sights on all fronts, and it established more than 2,000 rest and recreation centers for service men and women. The army was partly responsible for the formation of the United Service Organizations (USO). Wherever disaster has struck, the Salvation Army has stepped forward with aid. The organization's official paper is the *War Cry*.

History. "General" William Booth, a former Methodist minister, conducted meetings to bring the Gospel to the poor of London's East End slums in 1865. His work was well received, and he organized the Christian Mission. In 1878, the mission changed its name to the Salvation Army, designed uniforms for both men and women officers, and adopted a semimilitary system of leadership. The cause spread, and the army now operates in 86 countries and colonies. It was established in the United States in 1880, and the founder's son, Ballington Booth, took command in 1887. The army has over 8,000 centers in the United States today. For membership in the United States, see RELIGION (table).

William Booth died in 1912. His son William Bramwell became general. He was succeeded by Edward J. Higgins. The founder's daughter Evangeline became the next general, and in 1939 George Carpenter succeeded her. Albert Osborn became general in 1946, General Wilfred Kitching in 1954, and Frederick L. Coutts in 1963. Erik Wickberg succeeded Coutts in 1969. Army headquarters are at 101 Queen Victoria Street in London. U.S. headquarters are at 120 W. 14th Street, New York, N.Y. 10011. NORMAN S. MARSHALL

See also BOOTH.

David Campbell, Van Cleve Photography

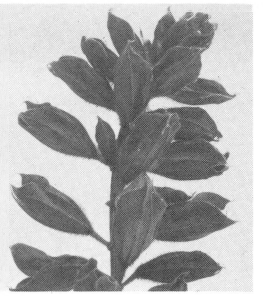
The Salvation Army provides many family welfare services, including day-care centers for the children of working mothers.

London Daily Telegraph from Woodfin Camp, Inc.

Religious Services are conducted in Salvation Army missions in many parts of the world. The organization also holds outdoor prayer meetings. A Salvation Army band accompanies most services.

SALVE REGINA COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SALVIA, *SAL vee uh,* is a group of plants that grow in the temperate and warm regions of the world. Salvias have two-lipped flowers that range in color from white and pale yellow to blue, purple, and scarlet. Gardeners use many kinds as ornamentals, including the *scarlet sage,* which has brilliant red flowers. It is native to Brazil, but is grown in other parts of the world. The *garden sage* used to flavor foods is a salvia. See also FLOWER (color picture: Fall Garden Flowers); SAGE.



J. Horace McFarland

Scarlet Sage

Scientific Classification. Salvias are in the mint family, *Labiatae.* They make up the genus *Salvia.* The scarlet sage is species *S. splendens,* and the garden sage is *S. officinalis.* H. D. HARRINGTON

SALWEEN RIVER, or SALWIN, is the second most important river in Burma. It rises in eastern Tibet, and flows through eastern Burma to the Bay of Bengal. It empties into the ocean near Moulmein. The river, 1,500 miles (2,414 kilometers) long, drains eastern Burma and western Thailand. It has little value as a commercial waterway, because much of it flows through a deep gorge. In its lower course, it is important for crop irrigation.

The Salween Delta is one of the most fertile sections in Burma. During flood season, the upper Salween River rises nearly 100 feet (30 meters) above its low water level and becomes a raging torrent. A suspension bridge carries the Burma Road over the upper river and is a vital transportation link. J. E. SPENCER

See also RIVER (chart: Longest Rivers).

SALYUT. See SPACE TRAVEL (Space Stations, with picture).

SALZBURG, *ZAHLTS boork* (pop. 128,845), is a city in the mountains of northwestern Austria. It is best known for its annual music festivals, which attract music lovers from all parts of the world. Wolfgang Amadeus Mozart, one of the world's greatest composers, was born in Salzburg. Salzburg is the capital of Salzburg province. See AUSTRIA (map). WILLIAM J. MCGRATH

SAM HOUSTON STATE UNIVERSITY. See UNIVERSITIES AND COLLEGES (table).

SAMA-VEDA. See VEDAS.

SAMAR. See PHILIPPINES (The Islands).

SAMARA. See KUYBYSHEV.

SAMARIA, *suh MAIR ee uh,* was the name of a city and its surrounding region in ancient Palestine. King Omri built Samaria in about 800 B.C., and made it the capital of the kingdom of Israel. The king named it after Shemer, who owned the land where it was built.

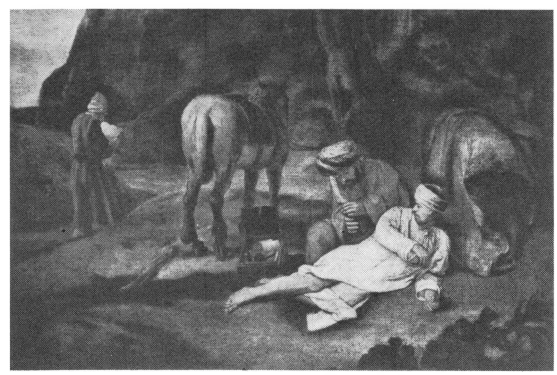
Assyria conquered Samaria in 721 B.C., after a siege of three years. In 331 B.C., the city fell to Alexander the Great. Then Hyrcanus attacked and destroyed it in 120 B.C. It was later rebuilt by Herod the Great, who called it *Sebaste.* Excavations begun in 1909 have yielded many ancient treasures. According to tradition, John the Baptist is buried there. Remains of the Crusaders' church, built in the 1100's, have also been found. Sabastiyah, Jordan, now stands on the site of Samaria.

See also SAMARITAN.

SAMARITAN, *suh MAR uh tuhn,* was a citizen of ancient Samaria. The Assyrians destroyed Israel in 721 B.C. and took the ablest Israelites to Assyria as captives. The Assyrian ruler then forced people from eastern Assyria to settle in the region of Samaria (see SAMARIA). The new settlers brought their own religious ideas, but also sought to please "the god of the land." Many of them intermarried with the remaining Israelites. People with this mixed ancestry and mixed religion came to be called *Samaritans.*

The Samaritans adopted the *Torah,* the first five books of the Hebrew Bible, as their scripture. But the Hebrews to the south refused to associate with them, and considered their religion inferior. When the Hebrews rebuilt their temple, they refused help that the Samaritans offered. Eventually, the Samaritans built a temple of their own, but it was destroyed in 128 B.C.

Jesus disapproved of the Jews' dislike for the Samaritans. When He was asked to define the term *neighbor,* Jesus told a story in which both a priest and a Levite passed by an opportunity to help a man in need. But a Samaritan stopped and helped the needy person (Luke 10:29-37). WILLIAM WILSON SLOAN



From a private collection, Paris

A Samaritan stops to aid a Jew in *The Good Samaritan,* painted by Rembrandt. The painting illustrates a parable told by Jesus.

SAMARIUM, *suh MAY rih uhm* (chemical symbol, Sm), is one of the rare-earth metals. Its atomic number is 62, and its atomic weight is 150.35. It is named after the Russian engineer Colonel Samarski. Paul Émile Lecoq de Boisbaudran of France discovered samarium in 1879. Samarium is best separated from other rare earths by ion-exchange processes. It has a silver color and slowly oxidizes in air. The common oxide, Sm_2O_3, has a pale yellow color, and is rapidly soluble in most acids. The metal melts at about 1072° C (1962° F.), and boils at about 1900° C (3452° F.). FRANK H. SPEDDING

See also ELEMENT, CHEMICAL (table); RARE EARTH.

SAMARKAND, *SAM ur kand* (pop. 272,000), is the second largest city and former capital of the Uzbekistan Soviet Socialist Republic. It lies in Turkestan. For location, see RUSSIA (political map). Samarkand serves as an educational center. Factories in the city manu-

facture silk goods, superphosphate, and tractor parts.

Samarkand occupies the site of ancient Maracanda. Alexander the Great destroyed Maracanda in 329 B.C. In the 1300's, Tamerlane, the Mongol conqueror, chose the city as his capital. THEODORE SHABAD

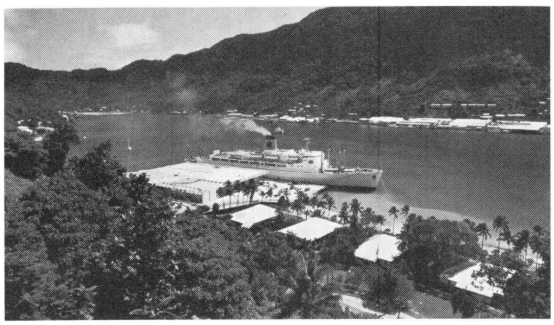
SAMBUKE. See ELDER.

SAMFORD UNIVERSITY. See UNIVERSITIES AND COLLEGES (table).

SAMNITE was a member of an ancient tribe in what is now southern Italy. The Samnites are known chiefly for their fierce battles against the Romans. The Romans expanded their empire to Samnite territory during the 300's B.C. The Samnites beat the Romans at the Battle of the Caudine Forks, but the Romans overpowered the Samnites in the 290's B.C. This greatly reduced the Samnite population. In the Social War of the 80's B.C., the Romans crushed the Samnites. Most Samnites adopted the Roman customs and language. HERBERT M. HOWE

SAMOA, *suh MOH uh,* is a group of 16 islands in the South Pacific Ocean about 4,800 miles (7,720 kilometers) southwest of San Francisco, Calif. The group was once called the Navigators Islands because of the fine canoes built by the Samoans. Samoa covers 1,173 square miles (3,038 square kilometers) and has a population of 196,000. Almost all the people are Polynesians.

The six eastern islands—Tutuila, Aunuu, the Manua group, and Rose Island—and Swains Island make up



Milt and Joan Mann

Samoa's Finest Harbor, at the port of Pago Pago, lies in an inlet of the island of Tutuila. Cargo and passenger ships dock there.

American Samoa. American Samoa has been under United States control since 1900. The nine western islands, including Savai'i and Upolu, make up Western Samoa. Western Samoa was administered by New Zealand for the League of Nations and the United Nations until it became an independent country in 1962.

Tutuila has the only good harbor in the islands. The United States had a naval base there until 1951.

Nearly all the Samoan islands are volcanic formations, and coral reefs surround most of them. Rich forests and flat lands slope gently toward the sea. The climate is hot and rainy.

See also AMERICAN SAMOA; WESTERN SAMOA; SWAINS ISLAND.

SAMOS, *SAY mahs,* is a Greek island in the Aegean Sea. It lies in the Grecian Archipelago, and is separated from the coast of Asia Minor by the Samos Strait. Samos once belonged to Turkey. It became a Greek island in 1913, after the Second Balkan War. Samos covers an area of about 184 square miles (477 square kilometers), and has a population of 41,124. Farmers of Samos raise olives and grapes. Limín Vathéos is the capital. For location, see GREECE (color map). HARRY N. HOWARD

See also POLYCRATES.

SAMOSET, *SAM oh set* (1590?-1655), was one of the early Indian friends of the Pilgrim settlers of the Plymouth Colony. He was a *sagamore* (chief) of the Pemaquid Indians, and apparently first came into contact with Englishmen when he met some fishermen along the coast of Maine. He learned a little English from them. In March, 1621, he startled the Plymouth colonists by appearing on the street and welcoming them in broken English. He later introduced the leaders of the colony to Massasoit, the Indian chief of the Plymouth area. In 1625, Samoset made what is believed to be the first deed of Indian land to English colonists. He transferred 12,000 acres (4,856 hectares) of his tribe's land to John Brown, one of the settlers. See also MASSASOIT. E. ADAMSON HOEBEL

Historical Pictures

Samoset's First Appearance in Plymouth Colony startled the colonists, who thought he was a dangerous savage. But Samoset proved to be a loyal and helpful Indian friend.

SAMOTHRACE, *SAM oh thrays,* or SAMOTHRÁKI, is a Greek island in the Aegean Sea, often mentioned in Greek mythology. The island covers 69 square miles (179 square kilometers) and has about 3,800 people. Agriculture, sponge fishing, and sulfur production are leading industries of Samothrace.

Ruins found on the island date from 500 B.C. In 1863, the famous statue of the Winged Victory of Samothrace was found on the island (see WINGED VICTORY). For location, see GREECE (color map).

SAMOYED, *SAM oh YED,* is the name of a tribe of Mongol people who live in the arctic region of northern Russia. The Samoyed people are much like the Lapps and the Eskimos.

SAMOYED is a dog bred by the Samoyed peoples of northern Siberia. It is related to the spitz and the chow. The Samoyed is used to guard reindeer herds and to pull sleds. The dog is intelligent, has a pleasant disposition, and is fast. The Samoyed has a muscular body covered with long, white hair. It stands about 23 inches (58 centimeters) high at the shoulder and weighs from 35 to 60 pounds (16 to 27 kilograms). OLGA DAKAN

See also DOG (color picture: Working Dogs).

SAMPAN, *SAM pan,* is a small, light boat, which is used chiefly in the rivers and harbors of China, Japan, and nearby islands. The sampan usually has a cabin with a roof made of mats. Many persons use these boats for homes. It is rowed with one or more oars, and some have a single sail. See also SHELTER (picture: Oriental Houseboats). ROBERT H. BURGESS

SAMPLER is a small square or strip of cloth covered with sample patterns of needlework. The term *sampler* comes from the Latin word *exemplar,* meaning a *pattern.* Adults first used samplers to record patterns of embroidery or lace. But as early as the 1500's, young girls learning to sew made samplers for practice or to show their skill.

Samplers were made of colored silks stitched on wool or linen canvas, or of lace patterns on closely woven linen. The girls often embroidered letters, numerals, quotations, and verses to gain experience with different techniques. Sometimes a girl would add her name, age, and the date the sampler was made. Many samplers had intricately embroidered birds, flowers, patterns of Bible verses, and even tiny human figures.

Samplers are mentioned in the literature and wills of the early 1500's. Many styles and shapes were produced in Europe and the United States until the end of the 1800's. Today, many museums and private collectors own early samplers. HELEN MARLEY CALAWAY

National Life Insurance Co.

A Young Woman Embroiders a Sampler Held in a Frame. Mottoes are particularly popular as sampler themes.

SAMPLING. See STATISTICS (Sampling).

SAMPSON, WILLIAM THOMAS (1840-1902), an American naval officer, became noted for the part he played in the Battle of Santiago during the Spanish-American War. When the war broke out in 1898, Sampson took command of the North Atlantic Squadron, and tried to stop the Spanish fleet from entering a Cuban port. But the Spaniards slipped into Santiago. Sampson blockaded the port until July 3, 1898, when the Spanish fleet, under Admiral Pascual Cervera y Topete, tried to leave and was destroyed. Sampson was away when the battle began, but quickly returned to his ships. Since Commodore Winfield Schley gave the initial orders, a quarrel developed over which man was responsible for the victory. A naval court of inquiry gave Schley credit, but also criticized his actions and strategy during the entire campaign. See SCHLEY, WINFIELD SCOTT.

Sampson was born in Palmyra, N.Y. He was graduated from the United States Naval Academy in 1857 at the head of his class. DONALD W. MITCHELL

See also SPANISH-AMERICAN WAR (Chief Events).

SAMSON was a hero of ancient Israel, famed for his great strength. His story is told in the Old Testament, Judges 13-16. In it, we see the beginnings of Israel's struggle with the Philistines in the 1000's B.C.

Consecrated before his birth by his mother's vow, Samson was forbidden to drink wine, eat impure food, or cut his hair. He fell in love with a Philistine woman who was unfaithful to him. So he set fire to the fields of her people. When the Hebrews handed him over for punishment, he broke loose and killed 1,000 Philistines with the jawbone of an ass. Later, the Philistines tried to capture him in Gaza by locking the city gates. But he tore out the gates and carried them away.

Samson's downfall came when he fell in love with a second Philistine woman, Delilah. She learned that the secret of his strength lay in his hair, and she had his head shaved while he slept. Samson was easily taken, blinded, and made to work as a slave. At the festival of the god Dagon, when the temple was filled with people, the Philistines led Samson in so the crowd could make fun of him. But his hair had grown back, and he was strong again. He seized the pillars that supported the roof, and pulled the building down, killing himself and thousands of his enemies. JOHN BRIGHT

See also DELILAH; GAZA.

SAMUEL was a Hebrew leader during the middle 1000's B.C. He was a prophet, priest, judge, and ruler. At this time, judges ruled the Hebrew tribes. Samuel, a judge, helped unite all the Israelites under a monarchy. He selected Saul, first king of Israel, and also chose David to succeed Saul. Samuel led in the struggle against the Philistines.

Samuel was born into a peasant family. His mother, Hannah, dedicated him at an early age to the service of God at the shrine at Shiloh. Some scholars believe that he not only became a priest, but also organized and led an important order of prophets.

The two books of Samuel in the Old Testament are named after him because of his prominence in I Samuel. They tell the story of the Hebrews from the birth of Samuel to the closing days of King David, a period of about a hundred years. The books are collections of stories written by various authors. They contain the important records of David. WALTER G. WILLIAMS

SAMUEL S. FELS FUND. See FELS FUND, SAMUEL S.

SAMUELSON, PAUL ANTHONY (1915-), is an American economist who has written extensively on all aspects of economic theory. He won the 1970 Nobel prize in economics.

In *Foundations of Economic Analysis* (1947), Samuelson showed the underlying unity of many economic principles and encouraged the use of mathematics in economic analysis. Samuelson revolutionized the teaching of economics by presenting the most advanced economic thinking at the introductory level. His college textbook *Economics: An Introductory Analysis,* first published in 1948, became the largest selling economics textbook in the world.

Samuelson was born in Gary, Ind. He received a Ph.D. from Harvard University in 1941 and has been

on the economics faculty at the Massachusetts Institute of Technology since 1940. In the early 1960's, Samuelson served as economic adviser to Presidents John F. Kennedy and Lyndon B. Johnson. LEONARD S. SILK

SAMURAI, *SAM u ry,* was the hereditary warrior class in feudal Japan. The term originally referred only to the imperial guards. After the coming of a feudal system, it meant the entire military class. This included the samurai warriors, the feudal lords called *daimyos,* or *daimios,* and the shogun (see SHOGUN). About 5 of every 100 Japanese belonged to this group.

A code of unquestioning obedience and loyalty, called *Bushido,* bound the samurai warriors to their lords. The samurai prized honor above wealth or life, and atoned for dishonor by committing hara-kiri, or ceremonial suicide (see HARA-KIRI). They wore two swords and a distinctive headdress. The samurai were graded in military ranks, each with an appropriate income in rice. They lost their privileges when the Japanese abolished feudalism in 1871. MARIUS B. JANSEN

SAN ANDREAS FAULT is the most active fault in California. It extends for more than 600 miles (970 kilometers), from Point Arena to the Colorado Desert. In 1906, horizontal movement of the earth's crust along the fault caused the great San Francisco earthquake (see EARTHQUAKE).

SAN ANGELO, Tex. (pop. 63,884; met. area 71,047), is an oil and a sheep and cattle ranch center in west-central Texas (see TEXAS [political map]). The city has the largest market in the U.S. for the purchase of wool from ranchers. The seat of Tom Green County, San Angelo serves as the trading center for 24 surrounding counties. Industries produce building materials, foods and beverages, furniture, leather goods, paint, sheet metal products, and trailers. San Angelo is the home of Angelo State University.

The city developed from a trading post established to serve Fort Concho, which was built in 1867 at the junction of the Concho rivers. It was originally called *Santa Angela,* but was renamed after a post office opened. At first a cattle-raising center, it became a center for raising sheep and Angora goats in the late 1800's. Oil was discovered in the 1920's. San Angelo has a council-manager government. H. BAILEY CARROLL

SAN ANTONIO, Tex., is one of the most historic cities of the United States. During its history, San Antonio has been under the control of Spain, Mexico, and the independent Republic of Texas. It has been called *Alamo City,* in honor of the famous Battle of the Alamo that was fought there in 1836.

Today, San Antonio ranks as one of the Southwest's leading cultural and trade centers and as the third largest city of Texas. Only Houston and Dallas are larger. Some of the nation's largest military bases are in the San Antonio area. The city lies on the rolling prairies of south-central Texas, about 150 miles (241 kilometers) northeast of the Mexican border.

Father Antonio Olivares founded San Antonio in 1718, when he established a Spanish mission at the site. The Spanish government chose this location because it wanted a settlement midway between its missions in eastern Texas and its military posts in northern Mexico. Members of an earlier Spanish expedition had named the site *San Antonio* for Saint Anthony of Padua.

The City, San Antonio covers about 198 square miles (513 square kilometers) in the center of Bexar County. Five independent communities lie within the city limits. They are Alamo Heights, Balcones Heights, Castle Hills, Olmos Park, and Terrell Hills. The San Antonio metropolitan area covers 2,531 square miles (6,555 square kilometers) and consists of all of Bexar, Comal, and Guadalupe counties.

A bend in the San Antonio River encircles the heart of downtown San Antonio in the center of the city. Shops, restaurants, and an open-air amphitheater line the riverbanks in a downtown area called *Paseo del Rio* (River Walk). *La Villita* (Little Village) occupies a square block along the downtown riverfront. It includes restored houses and shops built by San Antonio's early Spanish settlers.

The Tower of the Americas rises 622 feet (190 meters) east of the river. Its observation decks offer a view of San Antonio and the surrounding countryside. The tower was originally built for HemisFair '68, a fair that celebrated the city's 250th anniversary. About 25 nations of North and South America sponsored exhibits at the fair. North of the tower stands the San Antonio Civic Center. The center includes a convention and exhibit hall, a 2,800-seat theater, and a 10,000-seat arena. City Hall occupies the center of Military Plaza, west of the river. The Alamo, a restored Roman Catholic mission and site of the historic battle, stands in Alamo Plaza in downtown San Antonio. Other missions are south of the downtown area.

Residential areas spread in all directions from downtown San Antonio. Suburbs of the city include Hollywood Park, Kirby, Universal City, and Windcrest.

People. Almost 95 per cent of San Antonio's people were born in the United States. More than 40 per cent are of Mexican or Spanish descent, and much of the city's population speaks both English and Spanish. Other groups include persons of Belgian, Chinese, English, German, Irish, or Italian ancestry. Negroes make up less than 10 per cent of the population.

San Antonio has large slum areas, especially west of the downtown section, where many Mexican Americans live. Many blacks live east of downtown San Antonio. The San Antonio Urban Renewal Agency has worked with federal and local government agencies to improve the run-down areas and to build low-cost housing.

Unlike many other large cities, San Antonio has had few racial disturbances. The Roman Catholic Church has done much to promote the peaceful integration of

FACTS IN BRIEF

Population: 654,153. *Metropolitan Area Population*—888,179.

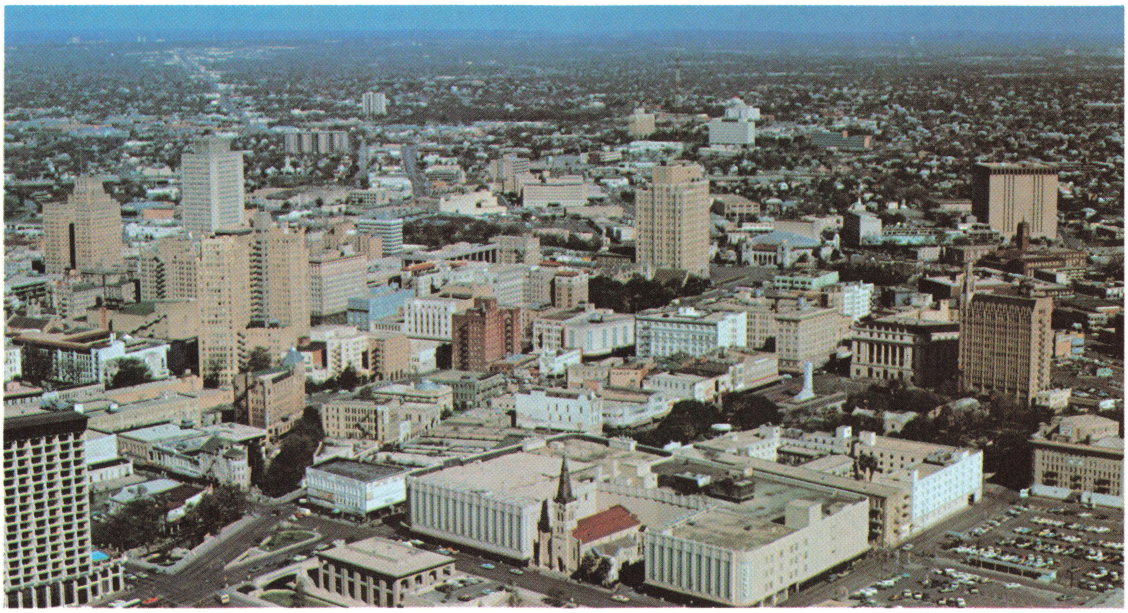
Area: 198 sq. mi. (513 km²). *Metropolitan Area*—2,531 sq. mi. (6,555 km²).

Altitude: 701 ft. (214 m) above sea level.

Climate: *Average Temperature*—January, 52° F. (11° C); July, 84° F. (29° C). *Average Annual Precipitation* (rainfall and other forms of moisture)—28 in. (71 cm).

Government: Council-manager. *Terms*—2 years for the 9 council members; manager appointed.

Founded: 1718. Incorporated as a city in 1837.



Greater San Antonio Chamber of Commerce

San Antonio is a leading commercial and cultural center of the Southwest. Joske's of Texas, one of the city's large downtown department stores, is built around St. Joseph's Church, *foreground*.

schools and other facilities. Roman Catholics form the largest religious group. The city also has many Baptists, Lutherans, Methodists, and Presbyterians.

Economy. Retail and wholesale trade activities employ about 25 per cent of the workers in the San Antonio area. The city is the chief outlet for farm products from the surrounding agricultural region. Many of the city's manufactured products are exported to Mexico.

Military bases in the San Antonio area employ more than 35,000 civilians. San Antonio is the home of Fort Sam Houston, headquarters of the U.S. Fifth Army. The U.S. Air Force operates four bases—Brooks, Kelly, Lackland, and Randolph—in or near the city.

About 1,300 manufacturing firms are in the San Antonio area. They produce goods worth over $300 million a year and employ about 10 per cent of the area's workers. These companies make aircraft parts, clothing, food products, fertilizer, medical supplies, oil field equipment, petroleum products, and other goods.

Medical and research facilities in San Antonio have made the city one of the Southwest's leading science centers. The South Texas Medical Center, scheduled for completion in the 1980's, includes hospitals, research centers, and the University of Texas Health Science Center. Brooke Army Medical Center at Fort Sam Houston and Wilford Hall Hospital at Lackland Air Force Base rank among the country's largest military medical facilities. The Southwest Research Center in San Antonio conducts research for government and industry.

San Antonio ranks as one of the leading convention cities in the Southwest. Conventions and tourism bring more than $3\frac{1}{4}$ million visitors a year.

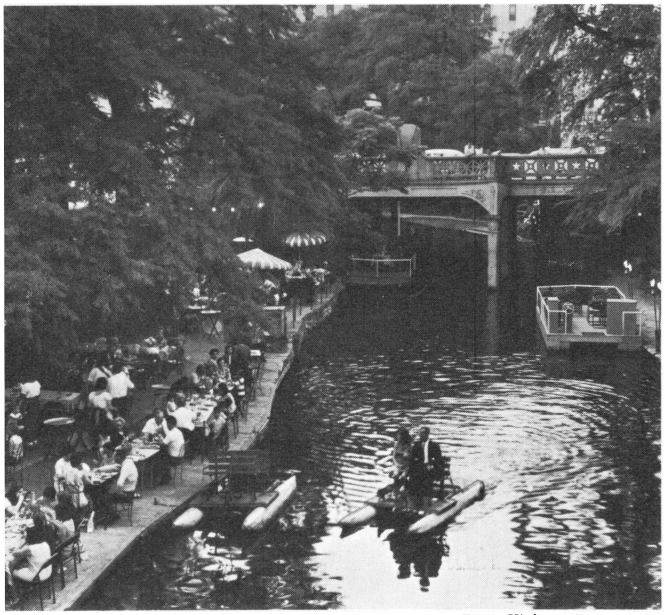
Three interstate highways link San Antonio with other parts of the country. About 30 truck lines and 3 railroad lines carry cargo to and from the city. The National Railroad Passenger Corporation (Amtrak) operates rail passenger service between San Antonio and other cities. San Antonio's International Airport handles flights to and from most major U.S. cities and several cities in Mexico.

San Antonio has three daily newspapers—the *Express*, the *Light*, and the *News*. Five television stations and about 25 radio stations serve the area.

Education. Fifteen independent public school districts serve Bexar County. They operate about 170 elementary schools and 70 junior and senior high schools. These schools have a total enrollment of approximately 200,000. About half the public school students are of Mexican or Spanish ancestry. Less than 10 per cent are black. San Antonio has about 60 private and church-supported schools, with a total of about 20,000 students.

The city's schools have a special problem because of the large Spanish-speaking population. Many Spanish-speaking students have difficulty understanding Eng-

Symbols of San Antonio. The red, white, and blue in the flag of San Antonio, *left*, represent the United States and Texas, which use these colors in their flags. The star on both the flag and the city seal, *right*, stand for Texas, the Lone Star State.



Texas Highway Department

Paseo del Rio (River Walk), a lively dining and shopping center in downtown San Antonio, borders the San Antonio River.

lish, the language commonly used for instruction. As a result, many of them fail in school and, in time, drop out. To combat this problem, some schools in the city's Mexican-American areas conduct classes in both English and Spanish in the lower grades. The federal Head Start program also operates in Mexican-American areas to teach English to preschool children.

Universities and colleges in San Antonio include Incarnate Word College, Our Lady of the Lake College, St. Mary's University, and Trinity University. Two campuses of the University of Texas are located in the city—the University of Texas at San Antonio and the University of Texas Health Science Center. The city is also the home of a branch campus of the National Autonomous University of Mexico, the largest university in Mexico.

The San Antonio Public Library system consists of a main library and eight branches. The library's Hertzberg Circus Collection includes a miniature circus and old circus posters.

Cultural Life. The San Antonio Symphony performs at the Convention Center Theatre. The Grand Opera Festival, held in March, features stars of the Metropolitan Opera. Theatergoers attend plays at the San Pedro Playhouse and other theaters.

The Marion Koogler McNay Art Institute displays American and European art works. The Witte Memorial Museum features exhibits on natural history and Texas culture. The Institute of Texan Cultures uses

CITY OF SAN ANTONIO

San Antonio lies on the San Antonio River in south-central Texas. The city is an important industrial, trading, and military center. The map shows the city's major points of interest.

City boundary
Main road
Other road
Rail line
Point of interest
Built-up area
Nonbuilt-up area
Park
Military area

WORLD BOOK map

exhibits and films to describe the roles of various nationality groups in Texas history.

Much of San Antonio's cultural life reflects the city's Mexican and Spanish background. The government of Mexico sponsors a Mexican American Cultural Exchange Institute in San Antonio to teach the customs and language of Mexico. The Alamo has been preserved as a museum. Other Spanish missions in San Antonio are Concepción, Espada, San Jose, and San Juan Capistrano. San Jose, called the "Queen of the Missions," is a National Historic Site. All the missions were built during the early 1700's.

Recreation. San Antonio has about 70 parks that cover a total of more than 4,300 acres (1,740 hectares). Brackenridge Park includes one of the nation's largest zoos, a sunken garden, and an outdoor theater. The San Antonio Spurs of the American Basketball Association play their home games in the HemisFair Arena.

The Fiesta San Antonio, held in April, celebrates the establishment of the Texas republic in 1836. This week-long festival features parades through the downtown area. The San Antonio Stock Show and Rodeo is held in February at the Joe Freeman Coliseum.

Government. San Antonio has a council-manager form of government. The voters elect the nine members of the city council to two-year terms. The councilmen elect one of their group mayor. They appoint a city manager to carry out the policies adopted by the council. Property and sales taxes provide most of the city's funds.

San Antonio's growing population has created several problems for the city government. The city needs more money to finance low-cost housing and to improve utility services and police and fire protection in run-down areas. Also needed are more jobs for semiskilled workers. To help remedy these problems, San Antonio has launched a drive to attract new industries. Such industries would increase the city's tax revenue and provide jobs for the unemployed.

History. Coahuiltec Indians lived in what is now the San Antonio area long before white settlers first came. During the 1500's, Spanish explorers traveled through what is now Texas. France claimed the area from 1685 until 1690, when Spain sent an expedition to Texas to re-establish its earlier claims. The Spaniards reached the Indian village of Yanaguana on June 13, 1691. That date was the feast day of Saint Anthony of Padua, and so the leaders of the expedition renamed the village and nearby river *San Antonio*.

San Antonio was officially founded in 1718, when the Spaniards built the mission of San Antonio de Valero on a small branch of the San Antonio River. They also built Fort San Antonio de Bexar to protect the mission from attacks by Apache and Comanche Indians. The mission, which became known as the Alamo, was later rebuilt at its present location. Mexico won its independence from Spain in 1821, and San Antonio came under Mexican rule.

Dissatisfaction with Mexican rule led the Texas settlers to revolt in 1835-1836. In one of the most famous battles in the struggle for Texas independence, about 187 men defended the Alamo against about 5,000 Mexican soldiers. On March 6, 1836, after a 12-day siege, the Alamo fell. The Mexicans killed all the defenders. But on April 21, Texas forces defeated the Mexicans in the Battle of San Jacinto, and Texas became independent.

In 1837, San Antonio was incorporated as a city of the Republic of Texas. The city began to grow rapidly after 1845, when Texas became a state. In 1850, 3,488 persons lived in San Antonio. Beginning in the 1860's, San Antonio thrived as a stop along cattle trails to Kansas. Businesses developed to trade in leather goods and supplies for the cattlemen. San Antonio's first railroad came to the city in 1877. Between 1876 and 1879, the construction of what is now Fort Sam Houston established San Antonio as an important military center. By 1880, the city's population had reached 20,550.

In the late 1800's and early 1900's, discoveries of oil near San Antonio aided the city's growth. After the United States entered World War I in 1917, San Antonio served as a leading military training and supply center. The increased military activity helped San Antonio's population jump from 96,614 in 1910 to 161,379 in 1920.

The city's growth rate slowed during the 1930's. But World War II (1939-1945) stimulated new growth, as San Antonio's military bases expanded. By 1950, the city had a population of 408,442. San Antonio more than doubled its area between 1950 and 1960 by annexing surrounding communities. These additions accounted for much of the city's population increase to 587,718 by 1960.

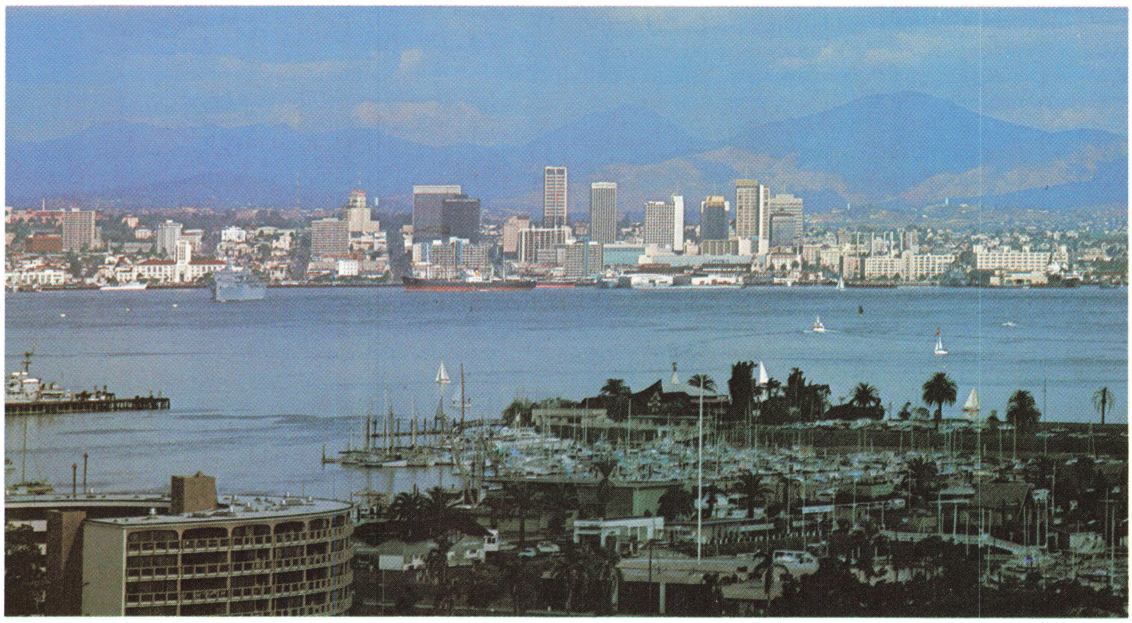
During the 1960's, urban renewal projects improved some of San Antonio's run-down areas. A new civic center was built and many historic buildings were restored. Projects scheduled for completion during the 1970's included new low- and moderate-cost housing for San Antonio's growing population. The 1970 U.S. Census listed San Antonio as the nation's 15th largest city, with a population of 654,153. BILL WAGNER

See also ALAMO; FORT SAM HOUSTON.

SAN BERNARDINO, *BUR nur DEE noh*, Calif. (pop. 106,869), lies at the foot of the San Bernardino Mountains, 58 miles (93 kilometers) east of Los Angeles (see CALIFORNIA [political map]). It is the chief trading center of a large mining and farming district in southern California. With Riverside and Ontario, it forms a metropolitan area of 1,141,307 persons. It is the home of California State College at San Bernardino.

The city was founded in 1810. A group of Mormons settled there in 1851, and helped lay out the townsite. San Bernardino is the seat of San Bernardino County, the largest county, in area, in the United States. The county covers 20,152 square miles (52,193 square kilometers). San Bernardino has a mayor-council form of government. GEORGE SHAFTEL

SAN BLAS INDIANS, *san BLAS*, is the term for four tribes of Indians that live on the San Blas Islands off the eastern coast of Panama. Most of the 20,000 Indians belong to the Cuna tribe. These Indians live now much as they did before Europeans came to Latin America. Tribal law prohibits marriage with whites. The highest proportion of albino births in the world occurs among these Indians (see ALBINO). Experts estimate that about 7 out of 1,000 San Blas are albinos. The albinos gave rise to the myth that a tribe of "white Indians" lived in Panama. See also PANAMA (picture).



Les Dalzell, Photophile

San Diego lies on San Diego Bay, one of the world's finest natural harbors. The bay helped make San Diego a naval center. It also serves fishing fleets and ocean-going ships.

SAN DIEGO, Calif., is one of the chief naval and aircraft centers of the United States. It lies in the southwestern corner of the country, on the United States-Mexico border. San Diego has one of the world's finest natural deepwater harbors. The harbor, which lies on San Diego Bay, serves ocean-going ships, tuna fleets, and U.S. Navy vessels. Large airplane manufacturers have helped make San Diego a major industrial center.

San Diego is one of the nation's fastest growing major cities. It ranked 43rd in population among U.S. cities in 1940, but rose to 14th by 1970. Of all the cities on the Pacific Coast, only Los Angeles and San Francisco are larger. San Diego also ranks as a major tourist center. Its zoo attracts more than 2½ million persons yearly.

The city is sometimes called *The Cradle of Californian Civilization.* It was founded in 1769, when Spanish soldiers built California's first *presidio* (military fort) on the site. The Spaniards chose the location because of the fine harbor. That same year, a Franciscan priest, Junípero Serra, established California's first mission in the presidio. The settlement was named for San Diego de Alcalá, a Spanish saint.

The City covers 327 square miles (847 square kilometers), including 8 square miles (21 square kilometers) of inland water. It is the seat of San Diego County. The San Diego metropolitan area extends over the entire county—4,313 square miles (11,171 square kilometers).

San Diego Bay forms part of the city's western border. Downtown San Diego extends inland from the bay to 12th Avenue. The Community Concourse, a modern civic center, is in the heart of the busy downtown area. It includes the City Administration Building, which houses the City Council chambers; the Civic Theatre, which can seat about 3,000 persons; Convention Center, designed to serve groups of up to 10,000; and Exhibit Hall, which has over 40,000 square feet (3,700 square meters) of display space.

The most heavily populated area in San Diego ex-

FACTS IN BRIEF

Population: 697,027. *Metropolitan Area Population*—1,357,-854.

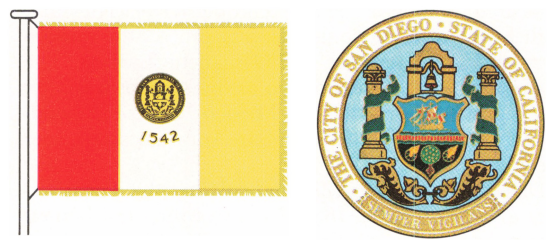
Area: 327 sq. mi. (847 km²). *Metropolitan Area*—4,313 sq. mi. (11,171 km²).

Altitude: 20 ft. (6 m) above sea level.

Climate: *Average Temperature*—January, 55° F. (13° C); July, 70° F. (21° C). *Average Annual Precipitation* (rainfall, melted snow, and other forms of moisture)—10 in. (25 cm).

Government: Council-manager. *Terms*—4 years for the mayor and 8 other council members; manager appointed.

Founded: 1769. Incorporated as a city in 1850.



Symbols of San Diego. The flag includes the city seal and the date 1542, when the explorer Juan Rodríguez Cabrillo sailed into San Diego Bay. The bell tower on the seal, *right,* symbolizes the influence of missionaries on the city's early development.

tends along the broad Mission Valley, north of the downtown section. The western part of the valley includes San Diego's Old Town district, the original center of the city. Many of Old Town's historic buildings and sites surround a plaza at Mason Street and San Diego Avenue. Point Loma, a peninsula on the western edge of San Diego, features the Cabrillo National Monument. It honors Juan Rodríguez Cabrillo, a Portuguese explorer who sailed into San Diego Bay in 1542. See CABRILLO NATIONAL MONUMENT.

San Diego's mild climate has made the city a popular vacation region. Temperatures average 55° F. (13° C) in winter and 70° F. (21° C) in summer. Many of San Diego's most fashionable residential and resort areas border the Pacific Ocean. These areas include La Jolla, Mission Beach, Ocean Beach, and Pacific Beach.

The San Diego metropolitan area has 12 incorporated cities besides San Diego. One of San Diego's best-known suburbs, the resort area of Coronado, lies on a peninsula in San Diego Bay. Other suburbs include Chula Vista, El Cajon, Escondido, Imperial Beach, National City, and Oceanside.

The People. More than 90 per cent of San Diego's people were born in the United States. People of Mexican ancestry make up about 10 per cent of the city's population, and blacks form about 7½ per cent. San Diego also has people of Canadian, Chinese, English, German, Italian, Japanese, and Portuguese descent. Roman Catholics make up the largest religious group in the city. San Diego also has a large number of Bap-

CITY OF SAN DIEGO

San Diego is a naval and aircraft center. The map at the right shows major landmarks in and around the city. The map below shows the Pacific coast from Los Angeles to Mexico.

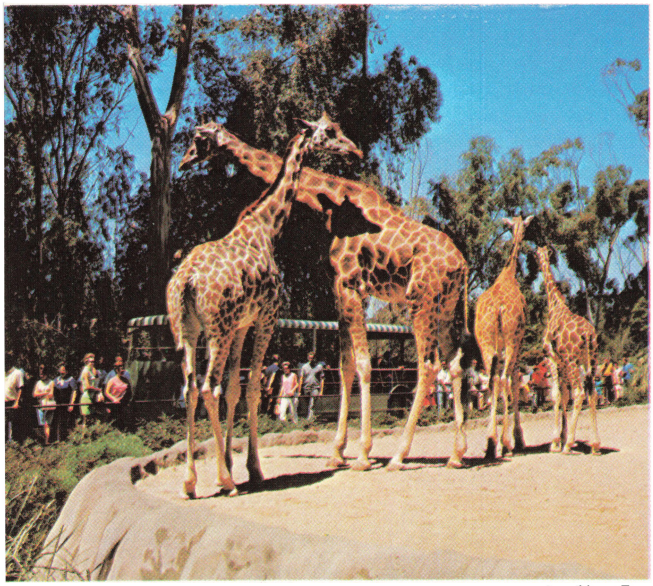
City boundary
County boundary
International boundary
Main road
Other road
Point of interest
Built-up area
Nonbuilt-up area
Park
Military area

San Diego and Los Angeles Area

0 25 50 75 Miles
0 25 50 75 100 Kilometers

0 5 10 15 20 25 Miles
0 5 10 15 20 25 30 35 40 Kilometers

WORLD BOOK map



San Diego Zoo

The San Diego Zoo has over 5,500 animals, one of the largest collections of any zoo in the world. Visitors may ride special buses through the zoo, a major tourist attraction in California.

tists, Jews, Lutherans, Methodists, and Presbyterians.

Large Mexican-American communities are on the south side of San Diego. Most of the city's blacks live in the east and southeast sections. Many Portuguese tuna fishermen and their families live in the Point Loma area. San Diego's mild climate has helped make the city one of the most popular retirement centers in the United States.

A shortage of low-cost housing is a major problem in San Diego. Many blacks, Mexican Americans, and servicemen live in crowded, run-down dwellings. Another problem is drug use by many of the city's young people. Large quantities of drugs that enter the United States illegally from Mexico go through San Diego.

Economy of San Diego depends heavily on military spending. Each year, the government spends more than $1 billion in defense funds in the San Diego area. This money goes chiefly to pay military personnel and civilian employees and to buy military equipment.

Government agencies employ about a fourth of the workers in San Diego County. Many of these men and women work at the San Diego Naval Base. This base includes the North Island Naval Air Station, which is the largest Navy air station on the Pacific Coast. See SAN DIEGO NAVAL BASE.

The nearly 1,000 manufacturing plants in San Diego County employ about a sixth of the county's workers. The chief industry is the manufacture of missiles and commercial and military airplanes. Nearly half the manufacturing employees work in the aerospace industry. Other major industries make electronic and oceanographic equipment, process salt, and build ships. Tuna canning is also important in the city. San Diego County leads the world in avocado production. It ranks among the top 20 U.S. counties in farm production.

The aerospace industry has brought much prosperity to San Diego. But in the 1950's and 1960's, sharp reductions in federal spending for airplanes caused considerable unemployment. San Diego is trying to lessen its dependence on aerospace manufacturing by offering undeveloped land at low prices to other industries.

Every year, several million tourists visit San Diego. They spend nearly $400 million annually. Leading attractions include the San Diego Zoo, Old Town, Mission San Diego de Alcalá, and nearby Tijuana, Mexico.

About 10 airlines use San Diego's Lindbergh Field. Railroad passenger trains and about 60 steamship lines serve San Diego. Two railroad lines and 50 truck companies provide freight service.

San Diego has two daily newspapers, the *Evening Tribune* and the *Union*. About 20 radio stations and 4 television stations serve the city.

Education. San Diego has about 150 public schools, with a total of more than 125,000 students. Blacks make up about 13 per cent of the enrollment, and Mexican Americans approximately 10 per cent. San Diego also has about 40 private and church-supported schools.

Colleges and universities in the city include Point Loma College, San Diego State University, the United States International University, and the University of San Diego. The University of California maintains both a branch campus and the Scripps Institution of Oceanography in San Diego (see SCRIPPS INSTITUTION OF OCEANOGRAPHY).

The San Diego Public Library system consists of the main library and more than 20 branches. The system owns over a million volumes.

Cultural Life. The Civic Theatre is the home of the San Diego Opera Company and the San Diego Symphony Orchestra. The Los Angeles Philharmonic Orchestra performs there annually. The Starlight Opera sponsors summer musicals in the open-air Wegeforth Bowl in Balboa Park.

The Broadway Theater League sponsors leading plays in the Civic Theatre. Other plays are staged in Balboa Park's Old Globe Theatre, a reproduction of the playhouse where many works of William Shakespeare, the famous English playwright, were originally performed. The theater presents the annual National Shakespeare Festival from June to September. The Fine Arts Gallery, also in Balboa Park, features paintings by European masters. The Timken Art Gallery next door owns a valuable collection of Russian religious paintings.

Balboa Park has other museums as well. The Aerospace Museum features replicas of famous airplanes. The Hall of Champions honors San Diego athletes, including former baseball star Ted Williams. The Museum of Man has displays on American Indians. The Natural History Museum offers exhibits on animals and plants in California. The Reuben H. Fleet Space Theater is the largest planetarium in the United States.

The *Star of India*, an iron sailing ship anchored in San Diego Bay, displays sea chests and ships' logs. The Serra Museum, in Presidio Park, has exhibits on San Diego history.

Recreation. San Diego has about 120 parks. Mission Bay Park, the largest, covers more than 4,200 acres

(1,700 hectares). This park includes Mission Bay, on the Pacific Coast. The park has beaches, as well as facilities for fishing, sailing, surfing, and water skiing. Sea World, the largest aquarium in the world, is also in the park. It features shows with a trained killer whale. The San Diego Zoo, which owns the world's largest collection of birds, mammals, and reptiles, is in 1,400-acre (567-hectare) Balboa Park. The zoo has more than 5,500 animals and over 100 acres (40 hectares) of tropical flowers and trees. The zoo also operates the San Diego Wild Animal Park in the northern section of the city. A monorail train carries visitors past herds of animals in the park, which opened in 1972. The park also features a reconstructed African village.

The San Diego Chargers of the National Football League play in San Diego Stadium. The San Diego Padres of the National League also play baseball in the stadium. The San Diego Conquistadors of the American Basketball Association and the San Diego Mariners of the World Hockey Association play in the San Diego Sports Arena.

Government. San Diego has a council-manager form of government. The voters elect a mayor and eight other city council members to four-year terms. The council appoints a city manager, who serves as administrative head of the government. Property taxes are the chief source of San Diego's income.

A rapid population growth has created several problems in the city. San Diego's chief needs include new schools, better highways, and a rapid transit system. City leaders are also working to reduce air pollution.

History. Diegueño Indians lived in what is now the San Diego area before white men first arrived there. Juan Rodríguez Cabrillo was probably the first European to see the area. Cabrillo, a Portuguese explorer in the service of Spain, sailed into San Diego Bay in 1542. But no white settlers came into the area until 1769. That year, Spanish soldiers built a presidio in what is now San Diego's Old Town area. Junípero Serra, a Franciscan priest, established San Diego de Alcalá, California's first mission, in the presidio that same year.

The trading of cattle hides became an important activity in the area during the early 1800's. Soon, San Diego's port helped make the settlement the center of the Pacific Coast hide trade. San Diego was organized as a town in 1834, and it became a city in 1850. By 1860, San Diego had a population of 731.

In 1867, Alonzo E. Horton, a businessman, bought the land in what is now downtown San Diego. He laid out an area called New Town near the city's wharf. This area soon became the new center of San Diego. In 1885, the California Southern Railroad reached San Diego. It was the first railroad in the city, and its arrival created a land boom. Business expanded rapidly, and by 1887, the city's population had jumped to 40,000. But the boom ended suddenly, and by 1890, the population had fallen to about 16,000.

During the early 1900's, a growing demand for tuna led to the establishment of large fish canneries in the city. The construction of these canneries also resulted from San Diego's location near tuna-fishing sites. In 1915, San Diego played host to the Panama-California Exposition, an international fair. The exposition brought worldwide attention to the city and made Balboa Park a popular tourist attraction.

San Diego became a naval center during World War I (1914-1918). The North Island Naval Air Station, in San Diego Bay, was established in 1917. By 1920, about 75,000 persons lived in the city. San Diego became the headquarters of the 11th Naval District in 1922. In 1935, Consolidated Aircraft Corporation (now General Dynamics-Convair) moved to San Diego from Buffalo, N.Y. The corporation soon became the city's largest civilian employer. By 1940, San Diego had a population of 203,341.

During World War II (1939-1945), San Diego's airplane plants attracted thousands of workers from throughout the United States. The armed services built new military bases in the city. Thousands of servicemen who received military training at these bases settled in San Diego after the war. By 1950, the city's population had soared to 334,387.

During the 1950's, increased competition from Japanese and South American tuna canneries and a slump in the aircraft industry hurt San Diego's economy. Gains in missile production and shipbuilding helped make up the losses.

A sharp decline in the aerospace industry during the early 1960's caused new large-scale unemployment in San Diego. City leaders established various programs to broaden the economy. Development of a 400-acre (160-hectare) industrial park helped attract many new industries to the city. By 1970, San Diego's population had increased to nearly 700,000. Completion of the Community Concourse in the early 1970's gave San Diego a modern, attractive civic center. GENE GREGSTON

SAN DIEGO, UNIVERSITY OF. See UNIVERSITIES AND COLLEGES (table).

SAN DIEGO MARINE CORPS RECRUIT DEPOT, Calif., trains U.S. Marine Corps recruits generally from west of the Mississippi River. It covers about 500 acres (200 hectares) and lies 3 miles (5 kilometers) north of downtown San Diego. The 544-acre (220-hectare) Camp Matthews Rifle Range, 12 miles (19 kilometers) north of the city, also forms part of the depot. The depot includes a recruit training command and schools. It was commissioned as a Marine Corps base in 1921.

SAN DIEGO NAVAL BASE, Calif., provides headquarters for several United States Pacific Fleet commands. These include the naval air force, cruiser-destroyer, amphibious force, and training commands, and the First Fleet. The base also includes the 11th Naval District Headquarters, a training center, a hospital, a naval station, a supply center, a recruit depot, and naval air stations on North Island and Miramar. There is also an anti-submarine warfare school, an anti-air warfare training center, and a recruit training command. An amphibious base is at Coronado, on San Diego Bay.

San Diego Naval Base covers 46,675 acres (18,889 hectares) and is the largest Pacific Coast naval base. Naval activity began there in 1917. JOHN A. OUDINE

SAN DIEGO ZOO. See CALIFORNIA (Places to Visit); SAN DIEGO (Recreation; picture).

SAN DOMINGO, a variant of Santo Domingo. See SANTO DOMINGO.

George Hall

Downtown San Francisco lies at the northeast corner of the city near San Francisco Bay. A bridge 8¼ miles (13.3 kilometers) long links San Francisco and Oakland via Yerba Buena Island, *right rear.* San Francisco skyscrapers include the pyramid-shaped Transamerica Corporation Building, *left rear.*

SAN FRANCISCO

SAN FRANCISCO, Calif., is one of the world's most beautiful and unusual cities. Its mild climate, exciting scenery, fine restaurants, and unusual places to visit give the city a special charm. San Franciscans boast that every visitor ends up wanting to live there.

Built on steep hills, the *City by the Golden Gate* faces water on three sides. The Pacific Ocean lies to the west. On the east is San Francisco Bay, the largest natural harbor in the world. To the north is the Golden Gate, a channel 1 mile (1.6 kilometers) wide that links the ocean and the bay. Ships pass in and out in a steady parade beneath the Golden Gate Bridge, one of the world's largest suspension bridges.

The best view of San Francisco can be seen from Mount Tamalpais, north of the Golden Gate. Early in the morning, the city's skyscrapers seem to float above the fog. Later in the day, white buildings clustered on the hills glisten in the bright sunlight.

In downtown San Francisco, gaily clanging cable cars seem almost to stand on end as they climb Nob Hill. The cars pass large hotels and fashionable shops. They skirt Chinatown, then cross Russian Hill to

FACTS IN BRIEF

Population: 715,674; met. area (San Francisco-Oakland), 3,108,782.

Area: 128 sq. mi. (332 km²), including 83 sq. mi. (215 km²) of inland water. *Metropolitan Area*—2,886 sq. mi. (7,475 km²).

Altitude: 65 ft. (20 m) above sea level.

Climate: *Average Temperature*—January, 50° F. (10° C); July, 59° F. (15° C). *Average Annual Precipitation* (rainfall, melted snow, and other forms of moisture)—20 in. (51 cm).

Government: Mayor-Council. *Terms*—4 years for the mayor and for the 11 supervisors.

Founded: 1776. Incorporated as a city, 1850.

City Seal: A shield in the center is supported by a miner to the left and a sailor to the right. Emblems of commerce, navigation, and mining lie at the men's feet. The shield pictures a steamship sailing through the Golden Gate. A phoenix rising from flames is above the shield and the city motto is below it.

City Flag: A phoenix rising from flames is in the center of the flag. The phoenix and the city motto below the figure are in gold. The words "San Francisco" appear in blue under the motto. A gold band borders the flag. See FLAG (picture: Flags of Cities of the United States).

City Motto: *Oro en Paz—Fierro en Guerra* (Gold in Peace—Iron in War).

Fisherman's Wharf on the waterfront. Throughout the downtown area, sidewalk flower stands add spots of bright color all year round. Store windows attract shoppers with displays of goods from many countries. More than 125 parks and recreation areas throughout the city provide green open spaces.

The people of San Francisco represent many nations. People came to the city from other lands after three important events. First was the Gold Rush of 1849 with its promise of sudden wealth. Second was the opening of the Panama Canal in 1914. The canal greatly shortened the sailing time from the eastern United States and Europe. Third was World War II in the 1940's. Thousands of American soldiers and sailors passed through the city and later returned to live there. In addition, many civilians came to help the war effort, and remained as permanent residents.

Downtown San Francisco

The city is built on and around 42 hills of the coastal mountain range. Much of the business district, however, rests on filled land that was the waterfront of Gold Rush days. San Francisco is almost square, lying on the 7-mile (11-kilometer)-wide tip of a peninsula.

The Waterfront is at the northeast corner of the city. A wide street called the *Embarcadero* runs parallel to the waterfront. Traveling from the Embarcadero, a visitor can see ships from many countries at the docks and wharves.

The famous *Fisherman's Wharf* is at the north end of the waterfront. Here, the visitor can take his choice of nearly 20 restaurants that serve seafood to as many as 5,000 persons an hour. He can buy souvenirs at dozens of shops. Or he can watch dozens of small fishing boats coming into the wharf with loads of fish and crabs.

Moored next to Fisherman's Wharf is the *Balclutha*, a three-masted sailing ship that rounded Cape Horn 17 times during the 1880's and 1890's. Owned by the San Francisco Maritime Museum Association, the *Balclutha* has been completely restored. It is the last surviving ship of the hundreds that once made the dangerous voyages around South America to San Francisco.

Three blocks west of Fisherman's Wharf, the visitor finds *Aquatic Park* and the *Maritime Museum*. The park provides salt-water swimming, fishing, and other outdoor activities. The museum preserves relics of the ships and the sailors that made San Francisco a great port.

In the middle of the waterfront area stands the *Ferry Building* with its clock tower. Large ferryboats used to carry passengers across San Francisco Bay to Oakland, Calif. The building now serves as a world trade center. It houses exhibits of goods from many countries, and has several foreign consulate offices.

Market Street, the main street of the downtown area, crosses the city from northeast to southwest. It starts at the Ferry Building and runs about 3 miles (5 kilometers) to the *Twin Peaks Tunnel*. The tunnel cuts through the high hills in the city's center to reach the southwest section.

Montgomery Street, the financial district, extends off Market Street to the north. It bustles with office workers during the day. Gleaming skyscrapers in this area include the Crown-Zellerbach, Shell, Equitable, and Standard Oil buildings.

Nob Hill rises north of Market Street. At the foot of

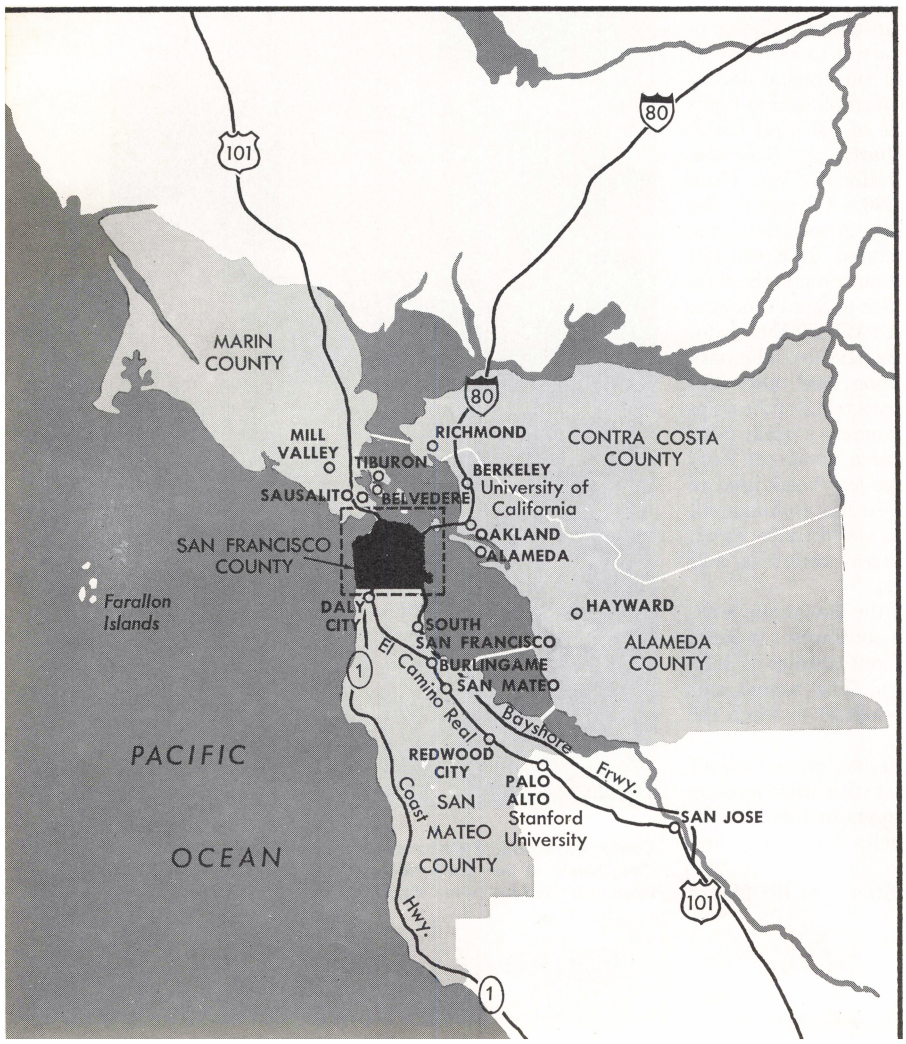
George Hall

Cable Cars add to the unique charm of San Francisco. They clang loudly as they carry riders past large hotels and elegant shops and climb such steep slopes as Nob Hill and Russian Hill.

Pacific Resources, Inc., Aerial Photographic Division

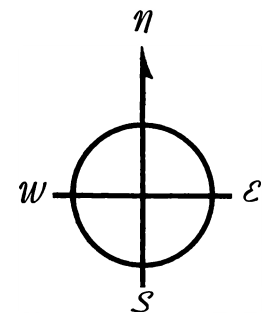
San Francisco's Busy Docks lie on San Francisco Bay, *above*. The San Francisco-Oakland Bay Bridge, *foreground*, and the Golden Gate Bridge, *rear*, link the city with nearby communities.

SAN FRANCISCO



METROPOLITAN AREA

The San Francisco-Oakland metropolitan area is shown in gray. It includes five counties—San Francisco, Marin, Contra Costa, Alameda, and San Mateo. The city of San Francisco (San Francisco County) is shown in black. The dotted line encloses the area of the large map, *right*.

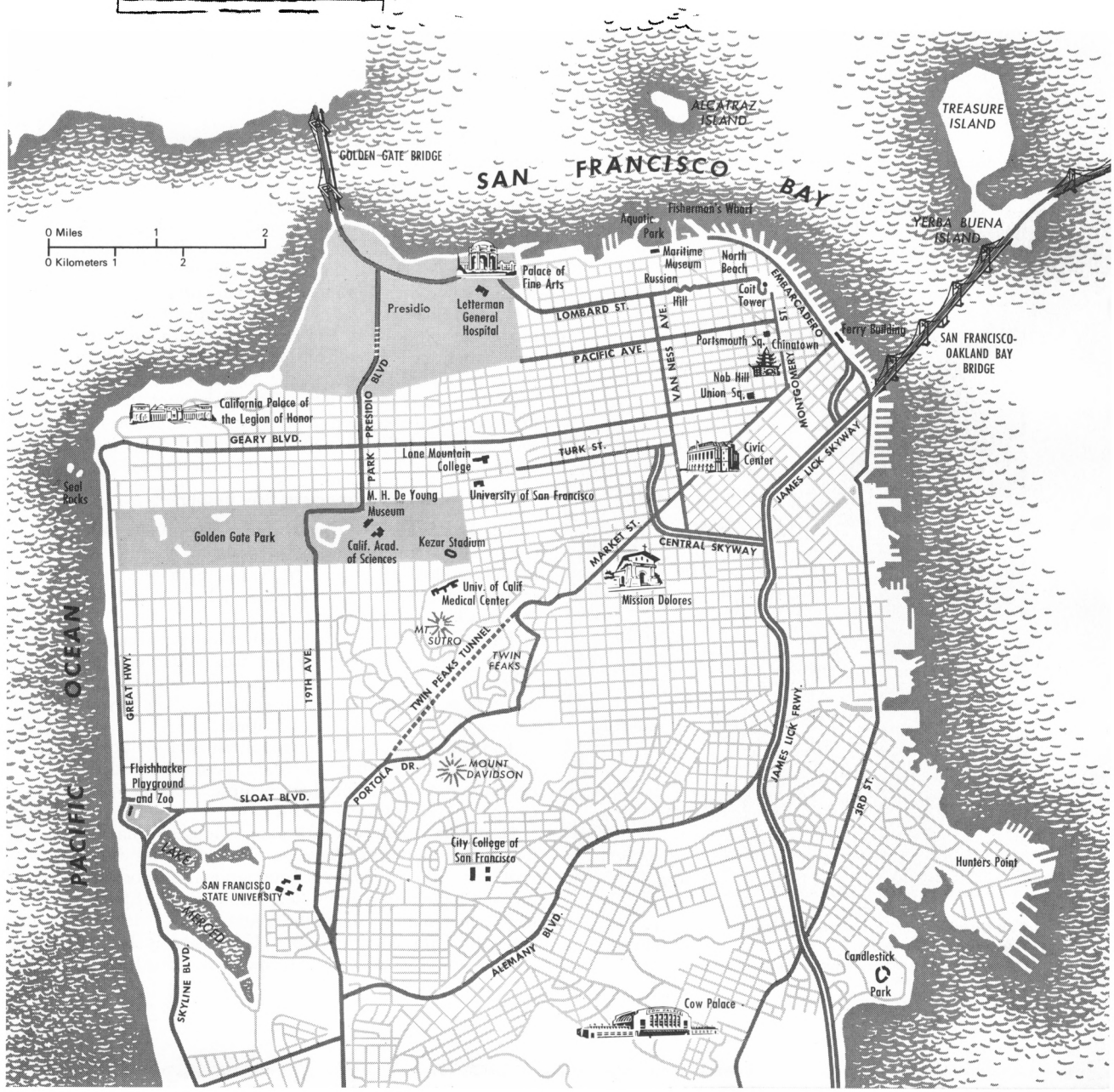


THE CITY

The city of San Francisco lies on a peninsula between San Francisco Bay and the Pacific Ocean. The city limits include the entire county of San Francisco.

San Francisco Convention & Visitors Bureau

Fisherman's Wharf, *above,* is known for its seafood restaurants. Fishing boats bring fresh fish, crabs, and other seafood to the wharf daily.

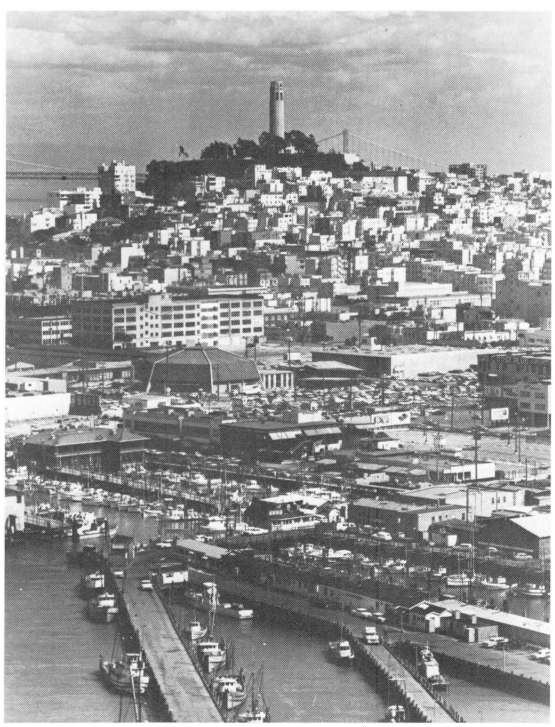


the hill, the city's main shops, restaurants, and hotels center in a few blocks. The Emporium is the largest department store. The St. Francis Hotel overlooks Union Square. This park lies on the roof of a huge automobile parking garage dug four stories deep. On Nob Hill stand two hotels, the Fairmount and the Mark Hopkins. The Top of the Mark lounge at the Mark Hopkins gives an excellent view of San Francisco Bay.

Chinatown, one of the largest Chinese settlements outside Asia, spreads across a district near Nob Hill. About 32,000 Chinese live there. Shops, restaurants, and even buildings with modern fronts have Chinese-style upturned roofs. Oriental clothing, furniture, porcelain, and toys fill the shops. Strange and exotic Asian foods crowd the windows of grocery stores. A stainless steel statue of Sun Yat-sen by Beniamino Bufano stands in St. Mary's Square.

Russian Hill is north of Nob Hill. It received its name because its early residents were Russians. It is famous for Lombard Street, the crookedest street in the city. Flowers and shrubs border the sharp S-curves of this unusual street.

Telegraph Hill stands east of Nob and Russian hills. *Coit Tower*, a shining white memorial to San Francisco's firemen, rises on Telegraph Hill. From the east side of the hill to the bay is the section known as *North Beach.* A famous entertainment area, the *Latin Quarter*, is in this section. Most of the people who live there are of Italian descent. Visitors enjoy many-course Italian dinners at the dozens of restaurants in this section.



San Francisco Convention & Visitors Bureau

Coit Tower, *rear,* **a famous San Francisco landmark, stands on Telegraph Hill. The North Beach section of the city lies between the tower and Fisherman's Wharf,** *foreground.*

The Civic Center is on Van Ness Avenue just north of Market Street. Important public buildings grouped there include the city hall, the public library, the civic auditorium, state buildings, the modern art museum, and the opera house.

The Presidio, originally a Spanish army post, has about 1,500 acres (607 hectares) of wooded parkland in the northwest corner of the city. For many years it has been the headquarters of the U.S. Sixth Army. The officers' club is in a long, low adobe building built by the Spaniards in 1776. It is the oldest building in the city. The Presidio is also the site of Letterman General Hospital, the largest military hospital in the western states. The nearby Palace of Fine Arts is the last remaining building of San Francisco's Panama-Pacific International Exposition of 1915.

Seal Rocks, in the ocean off the northwest corner of the city, are a playground for sea lions. Visitors can watch the playful animals from Cliff House, a restaurant overlooking the ocean.

Golden Gate Park, with more than 1,000 acres (400 hectares) of woods and lakes, extends from the Pacific shore to the center of the city. It has long bridle paths, four museums, and two stadiums. A public beach runs along the western side of the city from Golden Gate Park to Lake Merced.

Lake Merced, a large freshwater lake in southwestern San Francisco, provides boating and fishing. It is bordered by a public golf course and two private golf courses. Nearby, *Fleishhacker Playground and Zoo* features a heated salt-water swimming pool 1,000 feet (300 meters) long. The San Francisco campus of California State University lies east of the lake. Northeast is Sigmund Stern Grove, where Sunday concerts are presented.

Hunters Point, a former U.S. Navy shipyard, juts into the bay in southeastern San Francisco. South along the bay shore from Hunters Point is *Candlestick Park*, where the San Francisco Giants of the National League play baseball. The San Francisco Forty-Niners of the National Football League also play there. Inland and just south of the city limits is the *Cow Palace*, a huge auditorium used for livestock shows and conventions.

The San Francisco Bay Region

San Francisco Bay covers about 450 square miles (1,170 square kilometers). It is more than 50 miles (80 kilometers) long and over 10 miles (16 kilometers) wide in some places. Two peninsulas shelter it from the Pacific Ocean on the west.

The metropolitan area of San Francisco includes five counties. San Francisco and San Mateo counties cover the southern peninsula. Marin County is on the northern peninsula. On the eastern shore of the bay are Contra Costa and Alameda counties.

The population of the metropolitan area divides almost evenly between the southern peninsula and the eastern bay area. The northern peninsula area of Marin County is more sparsely settled.

San Mateo County, south along the peninsula, has four main highways. *Bayshore Freeway* carries traffic past San Francisco's busy International Airport and on to San Jose. *El Camino Real* follows an old Spanish trail farther inland through the heart of many residential areas to Palo Alto. Stanford University is located nearby. *Skyline Boulevard* is a scenic drive along the hills

that rise in the center of the peninsula. The *Coast Highway* runs along the Pacific Coast side of the peninsula. Suburbs in San Mateo County include Daly City, Redwood City, San Mateo, and South San Francisco.

East of the Bay, across the 8¼-mile (13.3-kilometer) San Francisco-Oakland Bay Bridge, is Oakland, one of the largest cities in California. In the center of the city, tall buildings stand near Lake Merritt, a wild duck refuge. Nearby Berkeley is the home of the University of California. Other leading suburbs of the east bay region include Concord, Fremont, and Hayward.

Marin County, north of San Francisco across the Golden Gate Bridge, has only about 207,000 residents. Rugged Mount Tamalpais rises near the bay. Muir Woods, a forest of giant redwoods, stands on the slope of the mountain. Each suburb has special characteristics. Sausalito is an artists' colony. Belvedere has large homes alongside man-made lagoons. Tiburon has dockside restaurants where yachtsmen can tie up their boats to come ashore and eat. Mill Valley is the home of many businessmen and fishermen.

Islands. About 30 miles (48 kilometers) west of the Golden Gate are the *Farallon Islands.* These islands warn incoming ships they are close to San Francisco. In the fog that frequently curtains the Farallons, a number of ships have been wrecked on the islands.

Several famous islands lie in the bay. Tiny *Alcatraz Island* is the site of a former federal prison for dangerous criminals. *Treasure Island,* the largest man-made island in the world, was the setting of the Golden Gate International Exposition in 1939 and 1940. It is now the site of a naval station. Treasure Island is connected to *Yerba Buena Island* by a causeway. Yerba Buena has a coast guard station, and provides an anchor for the center of the long San Francisco-Oakland Bay Bridge. *Angel Island* was once an important immigration station.

Climate

Few homes in the San Francisco area have air conditioning, because of the ideal climate. September is the warmest month. But even then the temperature rarely rises into the 70's. January is the coldest month. But winter temperatures seldom drop to freezing.

Only about 20 inches (51 centimeters) of rain fall during the year, mostly in the winter months. But fogs occur frequently. Fog helps keep the temperature even and provides necessary moisture to keep plants green all year. The fog usually lifts by noon. Light snow occasionally falls, but rarely in measurable amounts.

San Francisco has cleaner air than most big cities because almost no coal is burned. Natural gas is the chief fuel. Most homes do not have screens on the windows because there are so few insects.

The Economy of San Francisco

More than a million persons work in the San Francisco metropolitan area. The area has about 15 ports, and even many persons not directly connected with ships owe their jobs to the shipping industry. Almost a fourth of the area's people work in wholesale and retail trade. Manufacturing, service occupations, and government each provide employment for about 200,000 workers. Food processing, printing and publishing, petroleum refining, and the manufacture of metal products make up the leading manufacturing industries. The main exports of the harbor include cotton, grain, lumber, machinery, paper, and petroleum products. Most of these goods go to the Far East.

San Francisco is the insurance and financial capital of the West. The world's largest commercial bank, the Bank of America, has its headquarters and over 50 branches in the city. Other banks, insurance companies, and investment firms employ more than 70,000 persons in the metropolitan area. The San Francisco Stock Exchange has been important since Gold Rush days.

The city ranks with New York City as a world communications center. Telephone and telegraph messages that cross the Pacific go through San Francisco. The city is also headquarters for the U.S. Information Agency's West Coast Voice of America. Daily newspapers include the *Chronicle* and the *Examiner.* More than 20 newspapers are published in various languages for people of foreign descent.

Education

San Francisco's many schools, colleges, universities, libraries, and museums have given the city a reputation for intellectual and artistic leadership. Universities and colleges in the area include the Berkeley campus and San Francisco Medical Center of the University of California, California College of Podiatric Medicine, Golden Gate University, Lone Mountain College, the University of San Francisco, the college of the San Francisco Art Institute, San Francisco State University, Simpson College, and Stanford University at Stanford.

The city has 130 public schools, with about 100,000 students. Some 30,000 students attend 50 private and parochial schools. About 4,000 Chinese boys and girls study Chinese language and culture in their own schools after public school hours.

Libraries. One of San Francisco's noted book collections is the Sutro Library on the campus of the University of San Francisco. It includes Shakespearean folios, early Mexican books, and books printed before 1500. The California Academy of Sciences and the California Historical Society also have important libraries. The Public Library at the Civic Center administers 25 branches and has more than 800,000 books.

Museums. San Francisco has a number of museums devoted to art, science, and history. The M. H. de Young Museum displays San Francisco historical items, and art treasures from ancient Egypt, ancient Rome, and medieval Europe. The California Palace of the Legion of Honor, a memorial to the state's World War I dead, has a fine collection of tapestries, paintings, and sculpture. Works by the Mexican painter Diego Rivera and other modern artists are the special interest of the San Francisco Museum of Modern Art. The California Academy of Sciences in Golden Gate Park includes the Morrison Planetarium, the Steinhart Aquarium, and African and North American halls.

Government

The city and county of San Francisco have identical boundaries. The two have formed a single municipal corporation since 1856. For some purposes, this corporation operates as a county, for others as a city.

In the city limits are the Farallon Islands, Alcatraz Island, Treasure Island, and Yerba Buena Island.

A board of 11 supervisors serves as the legislative body. The mayor, supervisors, and most other elected officials all have four-year terms. Municipal judges serve for six years. The mayor nominates members of the board of education who are then passed on by the voters. The city operates the local transit system, including buses, electric coaches, and cable cars.

History

Early Explorers and Settlers. Fog and the narrow entrance to the Golden Gate delayed the discovery of San Francisco Bay for more than 200 years. The Portuguese explorer Juan Rodríguez Cabrillo discovered the Farallon Islands in 1542. But Cabrillo did not sight the Golden Gate. The English explorer Sir Francis Drake may have seen it when he sailed along the California coast in 1579. He is believed to have anchored in Drake's Bay, north of San Francisco. In 1595, the Spanish explorer Sebastián Rodríguez Cermeño again found Drake's Bay. He renamed it *Puerto de San Francisco* (Port of St. Francis). This established the name San Francisco for the region.

Almost 200 years later, in 1769, scouts of a Spanish expedition under Gaspar de Portolá became the first white men to see San Francisco Bay. On Sept. 17, 1776, the Spaniards dedicated the *Presidio* (military post) of San Francisco. A mission was built that same year about 3 miles (5 kilometers) inland. It was named *Mission San Francisco de Asís*, in honor of St. Francis of Assisi. The original mission was destroyed, but another mission built in 1782 is still preserved. It became known as *Mission Dolores*, from nearby Lake Dolores. A few Mexican families settled near the mission. The settlement was called the *Pueblo of San Francisco*.

California became part of Mexico in the 1820's. In 1835, the Mexican governor appointed a British sailor, William Richardson, as captain of the Port of San Francisco. On the waterfront at the foot of Telegraph Hill, Richardson set up a tent made from a ship's sail. The tiny village that grew there became known as *El Paraje de Yerba Buena* (the little valley of the good herb). Jacob Leese, an American trader, arrived in Yerba Buena in 1836 and built the first wood frame house. Leese celebrated the Fourth of July that year by raising the Stars and Stripes alongside the Mexican flag for the first time in the village. By 1841, about 30 families lived in Yerba Buena and the Pueblo of San Francisco.

On July 9, 1846, during the Mexican War, the U.S.S. *Portsmouth* anchored off Yerba Buena. Sailors and marines rowed ashore. They hauled down the Mexican flag and hoisted the Stars and Stripes over the Custom House. This adobe building stood on the site of Portsmouth Square near today's Chinatown. Lieutenant Washington A. Bartlett was appointed as the first *alcalde* (mayor) under American rule. In 1847, Yerba Buena was officially named San Francisco.

Gold Rush. In 1848, San Francisco had 820 residents, 200 houses, 2 wharves, 2 hotels, and 1 newspaper, the *Star*. It was published by an American, Sam Brannen. When Brannen received news of the discovery of gold at Sutter's Mill on the American River, about 100 miles (160 kilometers) to the northeast, he led the rush for gold. Only seven persons remained in San Francisco.

By 1849, some 40,000 persons had swarmed to the gold fields. As the supply point for the adventurers, San Francisco became a city of tents and shacks filled with gold-hungry men. Ships from throughout the world were abandoned in the harbor as their crews deserted to seek gold.

Crime and Culture. The city was incorporated on April 15, 1850. But the government had difficulty keeping law and order. The Barbary Coast, a district around Pacific and Kearny streets, became a center of vice and crime. Crimes went unpunished. Fires broke out repeatedly. Many persons believed the fires were set to make it easier to rob houses while the owners were fighting the fires. Citizens organized vigilance committees to put down crime (see VIGILANTE). The Vigilantes seized, tried, and hanged suspected criminals. After their harsh methods restored order, control of the city returned to the legal authorities.

Fortunes made in the gold rush also brought culture to the city. Lavish houses were built on Nob Hill. Theaters opened. Debating societies were established. Leading actors, singers, and opera stars entertained the new millionaires.

Construction of the transcontinental railroad brought hundreds of Chinese to California to work as laborers. When the railroad was completed in 1869, San Francisco became the gateway to the Pacific. In 1873, Andrew S. Hallidie, a local engineer, designed the first cable car to travel up and down the city's steep hills. The cars move by gripping a continuously moving cable under the street.

Earthquake, Fire, and Dynamite. By 1900, the population of the city had grown to 342,782. At 5:13 A.M. on April 18, 1906, a heavy earthquake shook San Francisco. The first shock damaged the water system. As a result, the fires that broke out could not be controlled. Firemen and soldiers from the Presidio fought the flames day and night. Finally, on the third day, they used dynamite to destroy entire blocks of buildings to create a fire break. The whole business district and many homes lay in ruins. In three days, earthquake, fire, and dynamite had killed 700 persons and destroyed 497 blocks of buildings covering $4\frac{1}{2}$ square miles (12 square kilometers).

Continued Growth. San Franciscans quickly rebuilt the city. The new San Francisco displayed itself to the world at the Panama-Pacific International Exposition of 1915. The exposition marked the opening of the Panama Canal. The canal shortened the water route between San Francisco and the East Coast by more than half and brought expansion in shipbuilding.

The city continued to grow during the 1920's and 1930's. In 1936, the San Francisco-Oakland Bay Bridge was opened to traffic. The next year, the Golden Gate Bridge was completed. In 1939 and 1940, San Francisco celebrated its two great bridges with the Golden Gate International Exposition at Treasure Island.

During World War II, San Francisco became the world's largest shipbuilding center. Thousands of military personnel were stationed in and around the city. U.S. Navy ships streamed in and out of the Golden Gate. From April 25 to June 26, 1945, the city was host

to delegates from many nations as they drew up the charter for the United Nations organization.

As the metropolitan area population grew in the 1950's and 1960's, San Francisco faced many problems. These included the need for more schools, housing, recreation areas, and transportation routes. The 1960's and early 1970's saw tests and construction on the Bay Area Rapid Transit system (BART). The $1,400,000,000 system, which opened in 1972, carries commuters at speeds up to 80 miles (130 kilometers) an hour. The Golden Gate Development, a renewal project along the Embarcadero, includes housing and 45 acres (18 hectares) of parks and plazas. GERTRUDE M. CORDTS

Related Articles in WORLD BOOK include:

Alcatraz
Bank of America
Cable Car
California (pictures)
Farallon Islands
Gold Rush
Golden Gate
Golden Gate Bridge
Oakland
San Francisco Conference
San Francisco-Oakland Bay Bridge
Treasure Island Naval Station
Westward Movement (picture: "Gold Fever")

Outline

I. Downtown San Francisco
II. The San Francisco Bay Region
III. Climate
IV. The Economy of San Francisco
V. Education
VI. Government
VII. History

Questions

What is the Golden Gate?

What three events brought people of many lands to San Francisco?

Who were the Vigilantes? What did they accomplish?

What means did firemen use to bring fires under control after the earthquake of 1906?

In what ways is the climate of San Francisco unusual?

Where is the oldest building in the city located?

What is the main street of downtown San Francisco?

How is the population of metropolitan San Francisco divided?

What four main roads lead out of the city to the southern peninsula?

What historical event took place on the location of present-day Portsmouth Square?

SAN FRANCISCO, UNIVERSITY OF, is a coeducational school in San Francisco. It is conducted by the Society of Jesus of the Roman Catholic Church. The university has colleges of liberal arts, science, and business administration; schools of law and nursing; and a department of education. Master's degrees are offered in the graduate division. The University of San Francisco also conducts an evening college and a summer session. It began as St. Ignatius College in 1855 and received its present name in 1930. For enrollment, see UNIVERSITIES AND COLLEGES (table). CHARLES W. DULLEA

SAN FRANCISCO ART INSTITUTE. See UNIVERSITIES AND COLLEGES (table).

SAN FRANCISCO CONFERENCE. Delegates from the United Nations met in San Francisco on April 25, 1945, to form a world organization strong enough to prevent another global war. Representatives of the nations then winning World War II drew up the charter for the United Nations, providing a framework for further cooperation in time of peace.

The United States, Great Britain, Russia, and China sponsored the San Francisco Conference. They originally invited 41 nations to send delegates to the conference. Later, they also invited Syria and Lebanon to attend. When the conference met, it agreed to invite four more nations to send delegates—Argentina, Byelorussian Soviet Socialist Republic, Denmark, and Ukrainian Soviet Socialist Republic. This made a total of 51 nations, but only 50 were actually represented, because Poland's postwar government had not been formed and it could not send a delegation.

After two months of work, the conference drew up the United Nations Charter. The delegates signed it on June 26, 1945. Each nation agreed to fulfill its obligations under the Charter, settle disputes peacefully, cooperate in police actions, and help solve world economic and social problems. PAYSON S. WILD

See also UNITED NATIONS (The Founding of the UN).

SAN FRANCISCO CONSERVATORY OF MUSIC. See UNIVERSITIES AND COLLEGES (table).

SAN FRANCISCO-OAKLAND BAY BRIDGE is one of the longest bridges in the world over navigable water. It crosses San Francisco Bay between Oakland and San Francisco, Calif. The Bay Bridge is really a series of bridges. It is more than 8 miles (13 kilometers) long, including its two approaches. It carries two decks for traffic. Opened in 1936, it cost over $76 million.

One part of the Bay Bridge, consisting of two suspension bridges, reaches from San Francisco to Yerba Buena Island in the bay. The roadway passes through a double-deck, 540-foot (165-meter) tunnel on the island. From this tunnel, the bridge crosses to Oakland and Berkeley.

The upper deck of the Bay Bridge originally had six lanes—three in each direction—for automobile traffic. The lower deck had three lanes for buses and trucks, and two tracks for interurban trains. Train service stopped in 1958, and the lower deck was converted into a five-lane road for all eastbound traffic. The upper deck became a five-lane westbound, all-traffic road.

Halfway between San Francisco and Yerba Buena, the suspension spans are anchored to a concrete anchorage pier. The spans themselves are carried by suspension cables supported by towers extending about 500 feet (150 meters) above the water. The two center spans on each side of the anchorage pier are 2,310 feet (704 meters) long. The California Toll Bridge Authority and the California State Department of Public Works planned and built the bridge. E. R. FOLEY

See also SAN FRANCISCO (picture).

SAN GABRIEL DAM is the name of two flood control projects on the San Gabriel River in southern California. The Los Angeles County Flood Control District built both dams.

San Gabriel Dam No. 1 ranks among the largest and highest rock-fill dams in the United States. It rises 285 feet (87 meters), and has a crest length of 1,500 feet (457 meters). The reservoir had an original capacity of 43,928 acre-feet (54,184,400 cubic meters) of water. The dam was completed in July, 1937, at a cost of $17,001,132.

San Gabriel Dam No. 2 is sometimes called *Cogswell Dam.* It is a rock-fill structure, 270 feet (82 meters) high and 620 feet (189 meters) long. Its reservoir originally

stored 10,915 acre-feet (13,463,500 cubic meters) of water. This dam was completed in 1935, at a cost of $3,127,762. T. W. MERMEL

SAN JACINTO, *san juh SIHN toh,* **BATTLE OF.** The last battle of the war for Texan independence was fought near the San Jacinto River and Buffalo Bayou in Texas. The Mexican general, Antonio López de Santa Anna, commanded a force of over 1,200 men. The Texans, under General Sam Houston, had only about 910 men. Following a long retreat, the Texans took the overconfident Mexicans by surprise on April 21, 1836, and won a complete victory in just 18 minutes. Nearly every man in the Mexican army was killed or captured. Santa Anna himself became a prisoner the next day. The Texan losses were 9 killed and 30 wounded. General Houston was shot in the ankle during the battle. A monument commemorating this battle stands near Houston (see TEXAS [Places to Visit]). NORMAN A. GRAEBNER

SAN JOAQUIN RIVER, *wah KEEN,* is the chief stream in the southern part of the Central Valley of California. It rises on the western slope of the Sierra Nevada in Tulare County. The river flows southwest, then turns northwest to cross the fertile San Joaquin Valley. It joins the Sacramento River to form a delta near San Francisco Bay (see CALIFORNIA [physical map]).

The San Joaquin River is about 350 miles (563 kilometers) long. Deep-draft vessels can go about 50 miles (80 kilometers) upstream to Stockton, Calif. The San Joaquin Valley is one of the richest farming areas in the United States. Friant Dam, a part of the Central Valley Project, stands on the river. C. LANGDON WHITE

See also FRIANT DAM.

SAN JOSE, *san hoh ZAY,* Calif. (pop. 445,779; met. area pop. 1,065,313), is a major industrial city and one of the nation's chief centers of aerospace manufacturing. It lies in the Santa Clara Valley, about 50 miles (80 kilometers) south of San Francisco. For location, see CALIFORNIA (political map).

San Jose has a rich historic past. It was founded in 1777 as the first Spanish town in what is now California. The town was named Pueblo de San José de Guadalupe in honor of Saint Joseph. San Jose became California's first capital in 1849. San Jose State University, which opened in 1871, was the state's first public college. Until the 1950's, San Jose was known as a farming center and the home of the college. Since then, rapid industrial expansion has made it one of the fastest-growing cities in the United States.

The City lies between the Santa Cruz Mountains on the west and the Diablo Range on the east. San Jose covers about 148 square miles (383 square kilometers) and is the seat of Santa Clara County. The San Jose metropolitan area extends over the entire county—1,324 square miles (3,429 square kilometers).

The heart of downtown San Jose is the intersection of Park Avenue and Market Street. Chief public buildings in this area include the San Jose City Hall and the Community Theatre. San Jose State University lies at the eastern edge of the downtown area.

More than 95 per cent of San Jose's people were born in the United States. Persons of Mexican ancestry make up about 15 per cent of the population. Other groups in the city include those of Italian, Japanese, or Portuguese descent. Roman Catholics form the largest religious group in San Jose, followed by Baptists, Lutherans, and Methodists.

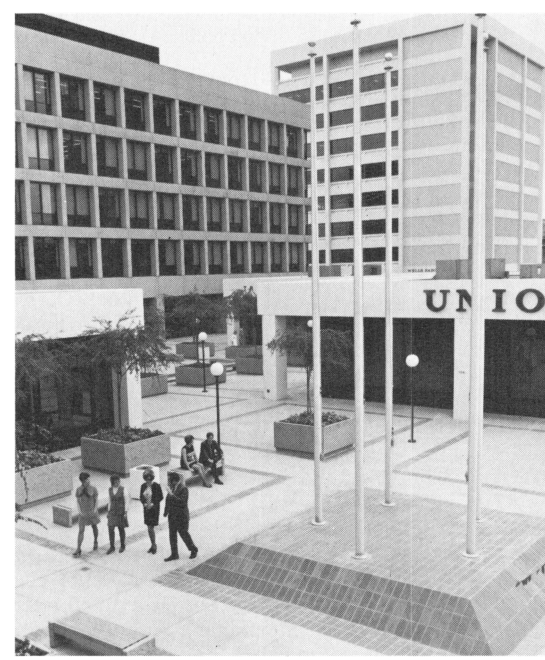
Economy. The more than 500 manufacturing plants in metropolitan San Jose employ about a third of the area's workers. Aerospace manufacturing ranks as the leading industry. Huge plants build missiles for the U.S. armed forces and space vehicles for the National Aeronautics and Space Administration.

Large canneries help make San Jose one of the major food-processing centers on the West Coast. The city is the main distributing point for the agricultural products of the fertile Santa Clara Valley. Other products of San Jose include business machines, chemicals, electrical equipment, fabricated metals, farm machinery, and motor vehicles.

Railroad passenger trains, 2 rail freight lines, and about 60 truck lines serve the city. The San Jose Municipal Airport lies $2\frac{1}{2}$ miles (4 kilometers) north of the downtown area. San Jose has two daily newspapers—the *Mercury* and the *News*—and nine radio stations and three television stations.

Education and Cultural Life. San Jose's public school systems include about 125 elementary schools, 20 junior high schools, and 15 high schools. The city also has about 20 private and parochial schools. More than 30,000 students attend San Jose State University in downtown San Jose. Nearby universities include Stanford University in Palo Alto and the University of Santa Clara in Santa Clara. The San Jose Public Library has more than 10 branches.

San Jose has a city chorus, an opera company, and a symphony orchestra. These groups perform in the Community Theatre. The city has about 75 parks and playgrounds. Alum Rock Park, the largest park, covers 776



Roed Associates, Inc.

San Jose's Park Center, a downtown complex built during the 1960's and 1970's, helped make the city a financial center.

acres (314 hectares). It features unusual rock formations and 22 mineral springs. Kelley Park includes a Japanese tea garden, a museum with exhibits on California history, and a zoo. The San Jose Municipal Rose Garden displays about 7,500 plants, including 158 kinds of roses. Rosicrucian Park includes an art gallery, a science museum with a planetarium, and a museum featuring exhibits on Egyptian history. This park is operated by the Rosicrucian Order, an international fraternity (see ROSICRUCIAN ORDER).

Government. San Jose has a council-manager form of government. The voters elect a mayor and the six members of the city council—all to four-year, part-time terms. The council hires a city manager as the administrative head of the government. The city manager carries out policies established by the council, prepares the budget, and appoints and dismisses department heads. San Jose gets most of its income from property and sales taxes.

History. The Olhone Indians lived in the San Jose region before the first white settlers came. In 1777, a group of Spanish colonists founded San Jose on the banks of the Guadalupe River. The town came under Mexican control during the 1820's. It grew slowly until the 1840's, when American pioneers began to arrive from the East. San Jose served as the state's first capital from 1849 to 1851. In 1850, when San Jose was incorporated as a city, it had a population of about 3,000. That same year, a stagecoach line linked San Jose and San Francisco.

In 1864, a railroad line connected San Jose and San Francisco. The railroad helped cause a land boom in San Jose, and the city's population reached 9,089 by 1870. Agriculture flourished in the San Jose area during the late 1800's, and apricots, grapes, and prune plums became valuable crops. During the first half of the 1900's, the city continued to be chiefly a farming and commercial center for the area south of San Francisco Bay. In 1950, prune plum orchards covered about 86,000 acres (34,800 hectares) near San Jose, and the city was known as the prune capital of the world. About 95,000 persons lived in San Jose by 1950.

Manufacturing grew rapidly in the San Jose area during the 1950's. The aerospace and electronics industries built large plants in metropolitan San Jose, and the area began to shift from a rural, farm economy to an urban, industrial economy. Jobs created by the new industries caused a population boom in San Jose. By 1960, the city had more than 200,000 persons.

San Jose started to annex nearby vacant land during the 1950's. Between 1950 and 1960, the city's area increased from 17 to 63 square miles (44 to 163 square kilometers). Large housing developments spread across former orchards and pastures. Continued industrial expansion helped San Jose's population double in the 1960's. The city's area increased more than 160 per cent during this period.

In 1968, work began on a downtown urban renewal project called Park Center. This $50-million project includes construction of several banks, office buildings, a hotel, and a civic theater. Completion was scheduled for the late 1970's. Work on another downtown urban renewal project, San Antonio Plaza, started in 1971. This project covers a decaying eight-block area between Park Center and San Jose State University. Plans called for the widening of streets and the construction of dormitories, open-air plazas, restaurants, stores, and a theater.

San Jose faced several problems in the 1970's. A shortage of low-rent housing has helped create a crowded slum in the eastern part of the city. Air and water pollution also remain major challenges. In addition, the city's growing population requires more schools and improved public transportation. STEVEN M. GIBSON

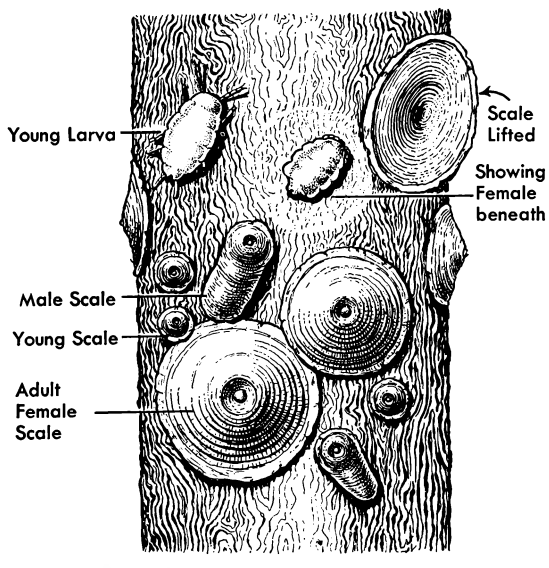
SAN JOSÉ (pop. 215,441; met. area pop. 438,658) is the capital and largest city of Costa Rica. It serves as the nation's commercial center and a market place for local farm goods. San José lies in a valley near the center of the country. For location, see COSTA RICA (political map).

The city's chief products include beverages, chemicals, processed foods, and textiles. Railroads link San José with ports on the Caribbean Sea and the Pacific Ocean. El Coco International Airport also serves San José. The city has many parks and tree-lined streets. Famous landmarks include the National Theater and the Post Office building.

Spanish settlers founded San José in 1751. During the late 1960's and early 1970's, the government replaced many slum areas of the city with low-cost housing. NATHAN A. HAVERSTOCK

SAN JOSE SCALE is an extremely destructive scale insect. It is commonly found on shrubs and fruit trees in all parts of the United States and Canada. The largest are no larger than the head of a pin. The branches of infected trees are literally powdered with their tiny bodies. Because these insects give off a gray scaly wax, the plants look as if they were coated with ashes. The San Jose scale sucks the sap of the host plant through a slender beak composed of several delicate stylets which fit together to form a tube.

The danger of the pest is increased by the great number of kinds of plants on which it can feed. These plants



Enlarged View of the Life Stages of the San Jose Scale shows the insects on the trunk of a fruit tree.

include fruit trees in orchard or nursery, the members of the rose family, the pecan, the English walnut, the elm, and other trees. The fruits of infected apple and pear trees show a reddish discoloration and are often rough, pitted, or cracked. A full-grown apple tree may resist these insects for several years, but a young peach tree is often killed in two seasons.

The pest takes its name from that of the city in California in which it was discovered in 1880. It is believed to have been introduced on trees brought from China. The San Jose scale was not found east of the Rocky Mountains until 1893, but by 1895 it was widespread.

The pest is spread by infected nursery stock. The scales are carried by the wind, and on the feet of birds and flying insects. The Chinese ladybird beetle and the chalcid fly are enemies of scales.

Scientific Classification. San Jose scales are in the armored scale family, *Diaspididae*. They are classified as genus *Aspidiotus*, species *A. perniciosus*. H. H. Ross

SAN JUAN, *san HWAHN*, Puerto Rico (pop. 452,749; met. area pop. 936,693), is the island's capital and chief seaport (see Puerto Rico [map]). The older part of the city lies on an island off the northern coast of Puerto Rico. Newer residential districts lie on the main island. Four bridges and a highway over the water link these parts of the city. Trade, various manufactures, and government are the chief activities. Some of the Spanish forts and the walls around the older part of the city are over 250 years old. San Juan National Historic Site, covering 48.25 acres (19.53 hectares), contains many of these fortifications. Morro Castle, begun in 1539 and completed during the late 1700's, lies on a bluff at the entrance to the bay, one of the best harbors in the West Indies. In 1521, followers of Ponce de León founded the city. It was the seat of the Spanish provincial government. See also Puerto Rico (pictures). Jaime Benítez

SAN JUAN BAUTISTA. See Puerto Rico (picture: Historic Puerto Rico).

SAN JUAN CAPISTRANO, *kah pih STRAH noh*, Calif. (pop. 3,781), is a city 60 miles (97 kilometers) southeast of Los Angeles (see California [political map]). It grew up around a mission founded in 1776. The mission is known for the swallows which leave every year about October 23 to winter in the south and return to Capistrano on March 19. George Shaftel

See also California (color picture).

SAN JUAN HILL, BATTLE OF. See Spanish-American War (Land Battles; map).

SAN JUAN ISLAND NATIONAL HISTORICAL PARK. See National Park System (table).

SAN JUAN ISLANDS are a group of over 170 islands bounded by Haro and Rosario straits. They lie between Washington and Vancouver Island, and belong to Washington. The islands, which cover 179 square miles (464 square kilometers) of land, have a population of 3,856. Lopez, Orcas, and San Juan are the largest islands. The islands are drier and sunnier than the mainland. Most people work at farming, fishing, or the tourist industry. Friday Harbor is the chief port. Spanish explorers named the islands. The United States acquired them from Britain in 1872. Howard J. Critchfield

SAN LORENZO, TREATY OF. See Alabama (Territorial Days).

SAN LUIS DAM, in the San Joaquin Valley of California, is one of the world's 10 largest earth-fill dams. It measures $3\frac{1}{2}$ miles (5.6 kilometers) long and 385 feet (117 meters) high and has a volume of 78 million cubic yards (59.6 million cubic meters).

The dam's reservoir stores water that flows through two canals from northern California. Farmers in southern California use most of the water to irrigate their land. The reservoir, which can hold more than 2 million acre-feet (2.5 billion cubic meters) of water, forms an artificial lake. San Luis Dam has eight generators, which can produce up to 424,000 kilowatts of electricity. The dam was completed in 1967. T. W. Mermel

See also Dam (Embankment Dams).

SAN LUIS POTOSÍ, *sahn LWEES poh toh SEE*, is a state of central Mexico. For location, see Mexico (political map). The state has a population of 1,281,996 and an area of 24,266 square miles (62,848 square kilometers). The Sierra Madre Oriental mountains cross the state from north to south. Farmers grow coffee, sugar cane, rice, tobacco, wheat, fruits, and vegetables. The state produces silver, gold, mercury, manganese, and antimony. The city of San Luis Potosí is the capital. See also San Luis Potosí (city). Charles C. Cumberland

SAN LUIS POTOSÍ, *sahn LWEES poh toh SEE* (pop. 230,039), is a farming and mining center in central Mexico. The city stands 225 miles (362 kilometers) northwest of Mexico City. It is the capital of the state of San Luis Potosí. For location, see Mexico (political map).

Spanish-style churches, public buildings, and houses from the 1600's stand in San Luis Potosí. Many people work in nearby silver, lead, and gold mines. The city is an important air and rail center. It stands on the highway between Mexico City and Eagle Pass, Tex. Industries include an aircraft plant, flour mills, textile mills, tanneries, breweries, furniture factories, and metal refining and smelting plants. John A. Crow

SAN MARCOS, UNIVERSITY OF, in Lima, Peru, is the oldest university in South America. It is also called the University of Lima. The school was founded in 1551 by King Charles I of Spain. Dominican friars supervised the university until 1571. During the 1600's and 1700's, the University of San Marcos was noted for its schools of law and medicine. The university was closed during the early 1800's and reopened in 1861. It became a government-supported institute in 1874. Today, it offers courses in letters and science, journalism, education, law, medicine, pharmacy, dentistry, economics, and veterinary medicine. The university has an enrollment of about 20,000. Emile Delavenay

SAN MARINO, *mah REE noh*, is the smallest republic in Europe. It covers an area of only 24 square miles (61 square kilometers). San Marino lies on the eastern slopes of the Apennine Mountains in northern Italy near the Adriatic Sea. The tiny country is completely surrounded by Italian territory (see Italy [political map]). The capital is San Marino, a walled city of about 4,400 persons. It is on Mount Titano.

Two *Captains-Regent*, assisted by a 10-member Congress of State, govern San Marino. The legislature, a 60-member Grand Council, is elected by the people every five years. It elects the Captains-Regent, who serve six-month terms.

The country's 19,000 people speak Italian, and are closely related to the people of northern Italy. They

Wide World

A San Marino Church, built in the 1300's, overlooks the town. San Marino is the capital of the tiny republic of San Marino.

are proud of their independence and their traditions. San Marino's chief sources of income are the tourist trade, postage stamps, and industry. About 2 million tourists visit the republic each year, and its stamps are popular with collectors in many countries.

San Marino was founded in the A.D. 300's by Marinus, a Christian stonemason from Dalmatia, who sought refuge from persecution by the Roman emperor Diocletian. The country has many fine historical buildings, including a church built in the 1300's. The present constitution of the republic was drawn up in the 1600's. In 1945, San Marino elected a Communist government. In September and October, 1957, it had two rival governments, Communist and anti-Communist. The Communists were defeated in the 1959 and 1964 elections. Women were given the right to vote in 1960 and the right to run for public office in 1973. CLARA BOSCAGLIA

See also FLAG (color picture: Flags of Europe).

SAN MARTÍN, *SAHN mahr TEEN*, **JOSÉ DE** (1778-1850), was an Argentine general who fought for the independence of South America in the wars with Spain. He and Simón Bolívar were the two great leaders in the cause of South American independence.

San Martín was born on Feb. 25, 1778, at Yapeyú in what is now Argentina. He went to Spain for his education. There he fought with the Spanish forces against Napoleon.

The Spanish colonies in South America began their rebellion against Spain, and in 1812 San Martín sailed for Buenos Aires. He was given command of a patriot army, and he planned a surprise attack against a Spanish army in Chile.

After nearly three years of preparation, San Martín undertook the campaign for which he is famous. He joined forces with Bernardo O'Higgins, the *George Washington of Chile*. In spite of terrible hardships, they led their army over the snow-covered Andes. In 1817, they appeared before the astonished Spaniards on the Chilean side of the mountains. The liberation army defeated the Spaniards at Chacabuco and the river Maipo. By the end of 1818, the liberators had driven the Spaniards out of Chile.

San Martín later went to Peru and helped that country win its freedom. In 1821, he was made Protector of Peru. In 1822, he met Bolívar for the first and only time at Guayaquil. San Martín gave up his command and returned to Argentina. He wanted to avoid any struggle for the leadership of the independence forces.

Little, Brown & Co.

José de San Martín fought for South America's independence from Spanish rule. (From *He Conquered the Andes,* by Mabel Lorenz Ives, illustrated by Forrest Orr.)

He became discouraged by the quarrels and disputes that disturbed Argentina after the liberation. He was too unselfish to take part in the struggle for power in Buenos Aires, and soon left for Europe. He died in France. E. TAYLOR PARKS

See also FLAG (color pictures: Historical Flags); PERU (The War of Independence); ARGENTINA (picture); CHILE (History).

SAN MIGUEL, *SAHN mee GEL* (pop. 55,470), is a trading and manufacturing city in El Salvador (see EL SALVADOR [map]). Its chief products include coffee, sisal fiber, indigo, cotton, gold, and silver.

SAN PEDRO SULA, *sahn PAY throh SOO lah* (pop. 58,632), is the second largest city of Honduras. It stands on the banks of the Chamelecón River. For location, see HONDURAS (map). It is the center of the banana and sugar-cane industries, and of trade for the northern and western interior. Industries include a brewery, a sugar mill, and the plants producing soap, candles, shoes, and cigarettes. ROLLIN S. ATWOOD

SAN QUENTIN is California's oldest prison. It was built with convict labor and opened in 1852. Some of the original buildings are still in use. San Quentin is about 10 miles (16 kilometers) from San Francisco. The prison has a normal capacity of about 2,700 men but has held as many as 3,900. Its official name is the California State Prison at San Quentin.

San Quentin is a *maximum security prison.* Such institutions hold prisoners convicted of violent crimes, and offenders who have been imprisoned repeatedly. Unpleasant living conditions and racial tensions have resulted in many killings, riots, and suicides at the prison. Some prison experts have recommended that San Quentin be closed.

The prison administration works to provide counseling, education, and other programs for the prisoners. San Quentin has a work-release program, under which selected inmates leave the institution during the day to go to work. HANS W. MATTICK

SAN SALVADOR (pop. 378,531) is the capital and largest city of El Salvador. The city, an important center of commerce and culture, lies about 25 miles (40 kilometers) from the Pacific Ocean. For location, see EL SALVADOR (political map).

Many industries developed in San Salvador during

the mid-1960's and 1970's. The city's leading products include chemicals, processed foods, and textiles. San Salvador has excellent transportation facilities. The Inter-American Highway connects it to other Central American cities and to cities in Mexico and the United States. Two railroads and the Ilopango International Airport serve San Salvador.

Pedro de Alvarado, a Spanish explorer, founded San Salvador in 1525. Earthquakes have damaged the city a number of times. San Salvador was destroyed by an earthquake in 1854, but the people rebuilt their city. NATHAN A. HAVERSTOCK

SAN SALVADOR ISLAND. See BAHAMAS.

SAN SEBASTIÁN, *sahn say bahs TYAHN* (pop. 165,829), is a seaside resort and the capital of the province of Guipúzcoa in Spain. The city has a landlocked harbor and a magnificent beach. The city lies on an isthmus in the Bay of Biscay. For location, see SPAIN (political map). San Sebastián was the summer residence of the Spanish royal family until 1931. The city serves as the official seat of the Spanish government from July 20 to October 1. STANLEY G. PAYNE

SAN STEFANO, TREATY OF. See BERLIN, CONGRESS OF; BULGARIA (Struggle for Independence).

SAN XAVIER DEL BAC MISSION. See ARIZONA (Places to Visit).

SANA, *sahn AH* (pop. 125,000), is the capital of Yemen (Sana). The city lies about 100 miles (160 kilometers) from the Red Sea, in a fertile district where fruits, vegetables, and some grains grow. Wells provide water for irrigation. A wall with eight gates surrounds the city. Most of the people are Moslems. The city is a trading center. For the location of Sana, see the map with the YEMEN (SANA) article. DOUGLAS D. CRARY

SANATORIUM. See SANITARIUM.

SÁNCHEZ CERRO, LUIS M. See PERU (The Growth of U.S. Influence; The Rise of APRA).

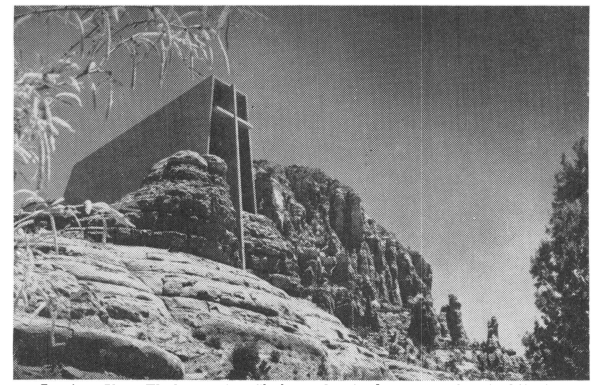
SANCHO PANZA. See DON QUIXOTE.

SAND is any earth material that consists of loose grains of minerals or rocks larger than silt but smaller than gravel. Engineers and geologists measure sand by shaking it through wire screens. Sand includes those grains less than $\frac{1}{12}$ inch (2.1 millimeters), but greater than $\frac{1}{400}$ inch (0.06 millimeter), in diameter.

Most grains of sand are parts of solid rocks that have crumbled away. Rocks break down in many ways. Some rocks crumble by the action of the air, rain, or frost. Strong waves wear away rocks by rolling over them and beating against them.

Sand is widely distributed on the earth. It is found at the bottom of the sea and shallow lakes. Sand is also rolled along the bottom of rivers and may be spread by the rivers over lowland areas. Great quantities are found on beaches. In desert areas, sand covers vast stretches of land. It is usually piled up by the wind in hills called sand *dunes*. These dunes have buried some ancient towns for hundreds of years.

Geologists find many types of minerals in sand. The most common one is *quartz*. Some sand consists almost entirely of quartz, but usually grains of many other minerals are also present. Other sand, such as that found on the beaches of many Pacific islands, consists of grains of *basalt*. Basalt is a black lava rock that has flowed from or has been blown out of volcanoes on these islands. Some Pacific island beaches have sand that consists of tiny particles of coral and shells of clams and snails, which are broken up by the waves.



Corning Glass Works; Julius Shulman for Anshen and Allen Architects

Sand Is Used to clean the walls of buildings, in molds used for casting, and as an abrasive. The concrete church, above, is made of sand, cement, and other materials.

Some river sands are rich in precious metals. These mineral deposits are called *placers*. The California pioneers took many millions of dollars' worth of gold from placers. Platinum, diamonds, and other valuable minerals also come from placers. Rare metals for jet engines come from placers in Florida, India, and Australia.

Sand has many practical uses. Manufacturers use quartz sand to make chemicals and glass. They make sandpaper by gluing loose sand onto heavy paper. Sand is also used in mortar and concrete. RICHARD M. PEARL

Related Articles in WORLD BOOK include:

Beach	Dune	Loam	Sandstorm
Desert	Glass	Sandstone	Silica

SAND, GEORGE (1804-1876), was the pen name of Amantine Lucile Aurore Dupin, a French novelist whose books were highly popular during the 1800's. She is best known today for her love affairs with the composer Frédéric Chopin and the poet Alfred de Musset. She defied social convention by such acts as smoking cigars and wearing men's clothes.

She was born in Paris and grew up in the tiny village of Nohant, which she later described affectionately in her novels. She went to Paris in 1831 to find a new life, after her marriage failed.

George Sand's many works can be divided roughly into four periods. From 1832 to 1837, she wrote novels of romantic passion, notably *Indiana* (1832), *Valentine*

(1832), and *Lélia* (1833). These novels reflect her own emotional desires and disappointments. They plead for a woman's right to sincere love and to lead her own life. From 1838 to 1845, she expressed her concern with social problems in such novels as *Consuelo* (1842). She dreamed of a world in which wealth would be abolished and brotherly love would unite all social classes. From 1846 to 1853, she wrote gentle, idealized novels of life in the French provinces. These include what is perhaps her best-known novel, *The Haunted Pool* (1846). Finally, from 1854 to 1876, she wrote simple stories resembling fairy tales.

Chicago Historical Society

George Sand

George Sand's characters are overidealized and her plots very artificial. Her style is poetic, but wordy and unoriginal. Today, her memoirs are her most interesting works, especially *The Story of My Life* (1854-1855) and *She and He* (1859), which concerns her relationship with Musset. IRVING PUTTER

SAND BAR. See OCEAN (diagram: How The Ocean Changes Coastlines).

SAND CHERRY. See BEACH PLUM.

SAND DOLLAR is an animal that lives in shallow coastal waters. Its thin, flat, circular body is 2 to 4 inches (5 to 10 centimeters) wide. The sand dollar looks somewhat like a silver dollar or a cookie. The body of many *species* (kinds) may contain slots, or be notched. The top surface has a set of breathing tubes that are arranged in the form of a five-point star. The sand dollar's body is covered with tiny movable spines which are used for crawling and digging.

The sand dollar lives slightly buried in the sand. Its food consists of tiny bits of animals and plants found among the sand grains. This food travels along the grooves on the underside of the sand dollar's body to its mouth, in the center of the under surface. Like the sea urchin and the starfish, the sand dollar is an echinoderm. The sand dollar resembles a flattened sea urchin.

Scientific Classification. Sand dollars belong to the phylum *Echinodermata*. They are classified in the class *Echinoidea*. ROBERT D. BARNES

See also ECHINODERM; SEA URCHIN; STARFISH.

SAND DUNE. See DESERT (picture); DUNE.

SAND FLY is a hairy, dark-brown insect about $\frac{1}{8}$ inch (3.2 millimeters) long. Female sand flies are active at night, and suck blood from man and animals. The *larvae* (young sand flies) live in moist places and feed on decaying plant and animal matter.

About half a dozen kinds of true sand flies live in the southern United States. But several hundred kinds thrive in the tropics and subtropics. They cause serious diseases, such as kala-azar and verruga peruviana.

Moth flies are related to sand flies, but they do not suck blood. Their wings fold over the body like a roof. Biting *midges* are sometimes called sand flies. They have two wings that lie flat on the back when the insect rests. In spring and fall, biting midges may appear in swarms. They rank among the smallest blood-sucking insects. Some of them are only $\frac{1}{25}$ inch (1 millimeter) long.

Scientific Classification. Sand flies, moth flies, and biting midges are all classified in the true fly order, *Diptera*. E. GORTON LINSLEY

See also DIPTERA; KALA-AZAR.

SAND MARTIN. See SWALLOW.

SAND PAINTING is the name for making pictures in sand. The Navajo Indians of the southwestern United States are noted for their sand painting, also called *dry painting*. The paintings form a part of many ceremonies, especially healing rites. Medicine men usually make sand paintings on the floor of a *hogan* (earth-covered dwelling). They get colored sands by grinding stones from nearby cliffs. They make the designs freehand and from memory, and destroy them after the ceremonies. Colored sand paintings were made in Japan in the A.D. 600's, and in England and France during the 1700's and 1800's. WILLIAM M. MILLIKEN

American Museum of Natural History

Sand Paintings make up an important part of Navajo Indian healing rites. The paintings are made by sprinkling powdered colored rock on a sand bed, under a medicine man's direction.

SAND VERBENA is a low summer annual with fragrant pink, white, or yellow flowers. The blossoms resemble those of the verbena, but the two plants are not related. Sand verbenas are native to western North America. The plants grow best in open, sunny places and in light soils. They are used for rock and seaside gardens. They adapt well to desert conditions.

Scientific Classification. Sand verbenas belong to the four-o'clock family, *Nyctaginaceae*. They make up the genus *Abronia*. One species is *A. umbellata*. ROBERT W. SCHERY

SANDAKAN (pop. 42,413) is the largest city in Sabah (North Borneo). It lies near the Sulu Sea, about 140 miles (225 kilometers) east of Kota Kinabalu (see BORNEO [map]). Ships connect Sandakan with Australia, Indonesia, the Philippines, and West Malaysia. Rubber plantations and lumber camps spread inland from the city. Sawmills and fisheries form Sandakan's largest industries. Sandakan was once the capital of North Borneo. See also SABAH. NORTON GINSBURG

SANDAL. See SHOE (History).

SANDALWOOD

SANDALWOOD is a scarce, valuable wood obtained from several related kinds of trees. These trees grow in southern India, Indonesia, and Australia. Sandalwood has a fairly straight grain. The wood also has a fine structure and is so heavy that it will barely float in water. The *heartwood* (center) has a yellowish-brown or orange color. Sandalwood has a fragrant odor from an oil it contains. Most sandalwood is shipped to China, where it is used in funeral ceremonies, for carving, and for incense in temples. It is well suited to making carved boxes, jewel cases, fans, combs, and walking sticks. Sandalwood oil is obtained by pressing the wood. The oil is used in perfumes, cosmetics, and medicines.

Scientific Classification. Sandalwood trees make up the family *Santalaceae*, and the genus *Santalum*. The principal species is *S. album* of India. HARRY E. TROXELL

SANDBLASTING is a method for engraving such materials as glass and granite or for cleaning metal and some buildings. Compressed air forces sand through a hose from the blasting machine. The sand acts as an abrasive to wear away scale on metal, dirt on stone buildings, or to smooth the surface of glass. Machines that have a rapidly rotating bladed wheel to hurl metal abrasives, particularly steel shot, are also used. Manufacturers prefer this method because it is faster and costs less. See also SAND (picture: Sandblasting); GLASS (How Glass Is Decorated). ALDEN E. LENHARD

SANDBUR, or BUR GRASS, is a troublesome prickly weed that originally came from the plains of the western United States. It now grows in sandy places in almost all temperate and tropical countries. A closely related species called the *cockspur* is common in the South.

The new Britton and Brown Illus. Flora of the Northeastern U.S. and Adjacent Canada by H. A. Gleason, © 1952

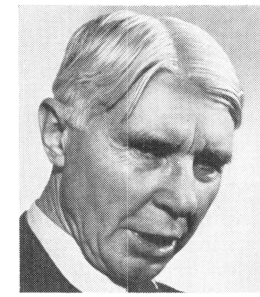
Sandbur

The stem of the plant grows from 1 to 2 feet (30 to 61 centimeters) high. It bears spikes with 10 to 20 shiny, sharp-spined burs that cause painful wounds when they prick the flesh.

Scientific Classification. Sandbur is in the grass family, *Gramineae*. Its several species belong to the genus *Cenchrus*. FRANK THONE

SANDBURG, CARL (1878-1967), was an American poet, biographer, and historian. Two major themes dominate his works. One is a search for the meaning of American history. The other involves his enthusiasm for the American common man. Quoting the English writer Rudyard Kipling, Sandburg said of himself: "I will be the word of the people. Mine will be the bleeding mouth from which the gag is snatched. I will say everything."

Sandburg was born in Galesburg, Ill. He left school at the age of 13 and did odd jobs around Galesburg for several years. Sandburg described his boyhood in the small Midwestern town in his highly praised autobiography, *Always the Young Strangers* (1953).



Schaal, Pix

Carl Sandburg

When he was about 18, Sandburg traveled throughout the Midwest as a hobo. After the Spanish-American War began in 1898, he served briefly in the U.S. Army in Puerto Rico. That same year, he returned to Galesburg, where he attended Lombard College. Sandburg left college in 1902 without graduating. For about 10 years, he was active in Socialist Party politics in Wisconsin.

Sandburg worked as a newspaperman, primarily in Chicago, from 1912 to the late 1920's. He first won fame—for his poetry—during that period. Then the success of the first part of his great biography, *Abraham Lincoln*, enabled him to leave journalism and concentrate on a literary career. Sandburg was one of several important writers who lived in Chicago from about 1912 to the mid-1920's. These writers included Sherwood Anderson, Theodore Dreiser, Ben Hecht, and Edgar Lee Masters. They are often called the *Chicago School*.

His Poetry. One of Sandburg's best-known early poems, "Chicago" (1914), portrays the brutality and ugliness he saw in American cities. The poem also pays tribute to the energy and power of modern industry. In making the city his subject, Sandburg followed a tradition in American poetry that began with Walt Whitman during the mid-1800's. In form, style, and theme, many of Sandburg's works resemble the poems in Whitman's collection, *Leaves of Grass*.

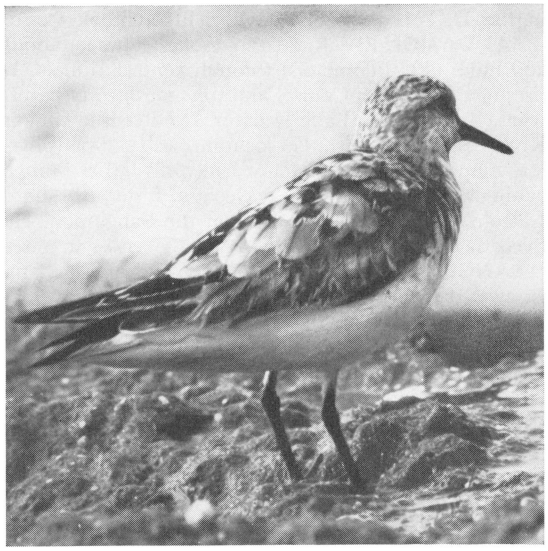
After 1920, Sandburg began to collect American ballads, folk tales, and legends. He presented many ballads and folk songs in *The American Songbag* (1927).

Sandburg introduced much American folklore into his poetry. In his long free-verse poem *The People, Yes* (1936), he included tall tales about such fictional and real characters as Paul Bunyan and Christopher Columbus. Sandburg ended the poem with the American people vigorously on the march, seeking new forms of self-expression, and asking the questions, "Where to? What next?"

Sandburg believed deeply in the value of life, and he strongly opposed war. In his dramatic short poems "Grass" (1918) and "A.E.F." (1920), Sandburg protested against the folly and waste of war.

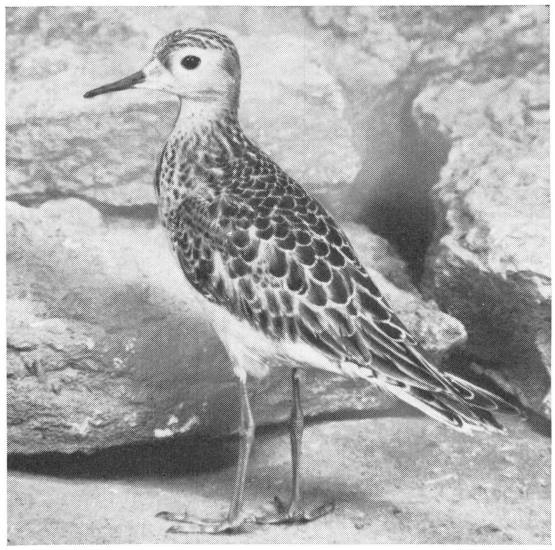
Some critics consider Sandburg's poetry crude and sentimental. But most agree that he accomplished his goal of being the voice of the American people and a spokesman for American democracy. His *Complete Poems* (1950) won the 1951 Pulitzer prize for poetry.

His Prose. To Sandburg, Abraham Lincoln represented all that was best in the American character. Sandburg also regarded the Civil War as the most important event in American history. From 1920 to 1939, he wrote six volumes of history about Lincoln and the Civil War. In *Abraham Lincoln: The Prairie Years* (two volumes, 1926), Sandburg dealt with Lincoln's career up to his election as President. Then, in *Abraham Lincoln: The War Years* (four volumes, 1939), Sandburg



Hugh M. Halliday, NAS

The Sanderling spends winters in the warmer regions of America. It looks for its food along the seashore.



G. Ronald Austing, NAS

The Semipalmated Sandpiper is one of the smallest of the shore birds. It is frequently called the black-legged peep.

provided one of the fullest accounts of Lincoln's presidency ever written. For this work, Sandburg received the 1940 Pulitzer prize for history. Many people rank this work as the finest historical biography of the 1900's. A one-volume edition was published in 1954.

Sandburg wrote three volumes of humorous stories for children—*Rootabaga Stories* (1922), *Rootabaga Pigeons* (1923), and *Potato Face* (1930). He also wrote a historical novel, *Remembrance Rock* (1948). CLARK GRIFFITH

See also LINCOLN, ABRAHAM (picture); SLANG.

SANDE, EARL (1898-1968), a famous American jockey, rode Kentucky Derby winners in 1923, 1925, and 1930. He gained a reputation as a quarter-mile rider and broncobuster before becoming a jockey in 1918. He went on to win 967 races and purses totaling $3 million. After retiring to become a trainer in 1932, Sande attempted a comeback as a jockey in 1953, but he won only one race. He was elected to racing's Hall of Fame in 1955. Sande was born in Little Falls, Idaho, on Nov. 13, 1898. RICHARD G. HACKENBERG

SANDERLING is a bird that belongs to the same family as the snipes and sandpipers. It differs from these birds by having only three toes. Sanderlings breed on Arctic beaches and tundra, and travel south in the winter. They appear then from California and Texas to South America and also on many Pacific islands.

The bird is about 8 inches (20 centimeters) long. Its feathers are hoary gray on the upper parts, and pure white beneath. It is a true beach bird and usually lives on seashores. Its favorite foods are small shellfish and marine insects that wash up with the tide. The female lays 3 or 4 eggs colored a brownish-olive. The eggs are speckled with darker markings.

Scientific Classification. The sanderling belongs to the snipe and sandpiper family, *Scolopacidae*. It is classified as genus *Calidris*, species *C. alba*. ALFRED M. BAILEY

SANDGLASS. See HOURGLASS.

SANDOW, *SAN doh,* **EUGENE** (1867-1925), a German strong man, performed great feats of strength in Europe and the United States. His fame helped make physical culture and body-building popular. Sandow was weak and sickly as a child. But he studied anatomy and built up his muscles. Sandow trained British soldiers during World War I. He was born in Königsberg, Germany (now Kaliningrad, Russia). RICHARD G. HACKENBERG

SANDOZ, *SAHN dohz,* **MARI SUSETTE** (1901-1966), was an American biographer and novelist. Her first book, *Old Jules* (1935), told of her father's hard farm life. She also wrote *Crazy Horse* (1942), a biography of an Indian chief; *Cheyenne Autumn* (1953), which treats Indian history; *Buffalo Hunters* (1954), which records the slaughter of the bison; and *Love Song to the Plains* (1961), which describes life on the Plains. She was born in Sheridan County, Nebraska. JAMES WOODRESS

SANDPAPER. See ABRASIVE.

SANDPIPER. A large number of birds are sometimes called sandpipers. But the name is usually given to small birds with long, sensitive bills. These birds live on the seashore in all parts of the world, and many *species* (kinds) of sandpipers build their nests north of the Arctic Circle.

Their plumage varies from buff to brown, gray, white, or black. The birds dig in the soft mud or sand in search of insects, worms, shrimps, and soft mollusks. They often follow receding waves, sometimes alone, sometimes in flocks, searching for bits of food. Their graceful movements and cheerful cries have made them popular birds. The female sandpiper lays 3 to 4 eggs that are colored a light gray, buff, or olive, and spotted with dark brown.

One of the best-known American species is the *spotted sandpiper*, which is found throughout the United States and southern Canada. The *Bartramian sandpiper*, also called the *upland plover*, is a useful bird that eats insects. It lives on dry uplands in the United States and Canada. Hunters once killed Bartramian sandpipers in great numbers. A larger species called the *willet* lives in marshes along the warm Atlantic and Gulf coasts, and

in many western states. Laws protect all sandpipers from hunters.

Scientific Classification. Sandpipers belong to the sandpiper and snipe family, *Scolopacidae*. The spotted sandpiper is genus *Actitis*, species *A. macularia*, the upland plover is *Bartramia longicauda*, and the willet is *Catoptrophorus semipalmatus*. ALFRED M. BAILEY

See also BIRD (color picture, Color Protects Them); GODWIT; RUFF; SNIPE; WILLET.

SANDSTONE is a rock made up of sand grains. The sand grains are cemented together by some substance, usually silica, clay, or carbonate of lime. Some sandstone contains quartz and looks glassy. This variety is used in making glass. Sandstone ranges in color from white to dark gray or brown. The cement gives sandstone its color.

Brownstone, a reddish-brown variety of sandstone, was once widely used in building houses in the eastern United States. Before the use of portland cement and reinforced concrete, sandstone was widely used to build large buildings. Some of the finest cathedrals in Europe were built of sandstone. RICHARD M. PEARL

See also BUILDING STONE; QUARRYING.

SANDSTORM is a storm that occurs when a strong wind carries sand through the air. It may result from the heat of the sun beating on broad deserts or plains. The rapid daytime heating of the lower air over deserts makes the heated air rise, and it is quickly replaced by cooler air. The wind that results may be strong and constant or intermittent and turbulent. Sandstorms in the southwestern United States result from strong wind gusts that sometimes accompany a passing cold front.

A desert trip is often a steady struggle against wind and blowing sand. Desert wind may carry fine dust that fills the eyes, nose, and throat. In India, sandstorm winds are called *peesash*, from the Hindu, or *shaitan*, from the Arabic name for devil. Sandstorms help shape sand dunes and rocky surfaces. JAMES E. MILLER

SANDWICH. See FOOD (Interesting Facts).

SANDWICH GLASS. See GLASSWARE.

SANDWICH ISLANDS. See HAWAII (Discovery).

SANDY HOOK is a low, sandy point of land reaching north from the New Jersey coast into New York Bay. Sandy Hook Bay is on the west of the peninsula, and the Atlantic Ocean lies to the east. The sandy waste is covered with poison ivy, huge holly trees, and beach-plum bushes. The Hook is 18 miles (29 kilometers) south of Manhattan Island. It is 6 miles (10 kilometers) long, and 1 mile (1.6 kilometers) wide at its widest point.

Fort Hancock is on the farthest tip of Sandy Hook. Part of the peninsula is used by the United States government as a testing ground for heavy guns. The tip of the Hook is guarded by a beacon, but the first light seen by incoming ships comes from a 90-foot (27-meter) lighthouse about 1 mile (1.6 kilometers) from the tip. This lighthouse, built in 1763, is the oldest one still in use in the Western Hemisphere. ERNEST L. THURSTON

SANFORD, MARIA L. (1836-1920), was one of the first woman professors in the United States. She taught at the University of Minnesota for 30 years. She became a leading educator of Negroes, Indians, and exceptional students. Minnesota placed a statue of her in the Statuary Hall collection in the U.S. Capitol, Washington, D.C., in 1958. She was born in Saybrook, Conn.

SANGAMON RIVER, *SANG guh mun*, flows for about 250 miles (402 kilometers) through central Illinois. It rises in Champaign County and runs south to Decatur, where a dam forms Lake Decatur. It enters the Illinois River near Beardstown. For location, see ILLINOIS (physical map). In 1830, Abraham Lincoln's father built a cabin on the north bank near Decatur. Later, Abraham Lincoln settled in New Salem on the Sangamon. He lived there from 1831 to 1837. PAUL M. ANGLE

SANGER, FREDERICK (1918-), an English chemist, won the 1958 Nobel prize in chemistry for developing a method of studying the structure of proteins. He helped establish the structure of insulin by working on its chemical constitution in different species of animals. He lived in Cambridge, England. PAUL R. FREY

SANGER, MARGARET (1883-1966), led the birth-control movement in America, and founded the Planned Parenthood Federation of America. A trained nurse, she felt that the poor needed to control the size of their families. It was illegal to distribute birth-control information, but she wrote booklets and opened clinics to advise people on the subject. She was arrested several times, but helped get laws passed permitting doctors to give birth-control information for the "cure or prevention of disease." She also worked for birth control in other countries, especially in India. She was born in Corning, N.Y. LOUIS FILLER

See also PLANNED PARENTHOOD.

SANGRE DE CRISTO MOUNTAINS, *SANG gree duh KRIS toh*, extend for more than 200 miles (320 kilometers) from central Colorado to north-central New Mexico. For location, see physical maps with COLORADO; NEW MEXICO. Blanca Peak in Colorado is 14,345 feet (4,372 meters) high, the highest in the system.

SANGSTER, CHARLES (1822-1893), was a Canadian poet. He started writing patriotic verses about 1860, at a time when political conditions in Canada were at their worst. His poems helped arouse national feeling in favor of union of the provinces. His works include *The Saint Lawrence and the Saguenay, and Other Poems* (1856) and *Hesperus and Other Poems and Lyrics* (1860). Sangster was born in Kingston, Ont. PETER VIERECK

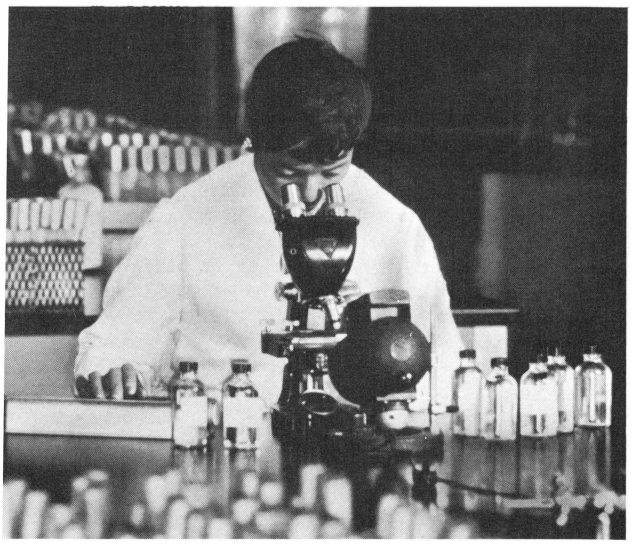
SANHEDRIN, *SAN hee drin*, was the highest national governing council of the Jews in Roman times. According to some scholars, there were two Sanhedrins. The 23 members of the political and civil Sanhedrin came mostly from among the Sadducees. The 70 members of the religious Sanhedrin, which was presided over by the high priest, came largely from among the Pharisees. Jesus was tried before the religious Sanhedrin. Peter, John, Stephen, and Paul appeared before it on charges of religious error. After the fall of Jerusalem in A.D. 70, the council declined and completely disappeared. See also GAMALIEL; SADDUCEE. LOUIS L. MANN

SANIDINE. See FELDSPAR.

SANITARIUM, *SAN uh TAIR ee um*, is a place where people go to improve their health. The word comes from the Latin word for health, *sanitas*. It is sometimes used as another word for *sanatorium*.

A *sanatorium* is an establishment where sick people are treated. It is especially used for a place where a particular treatment is given. THOMAS PARRAN

SANITARY ENGINEERING. See ENGINEERING (table: Specialized Engineering Fields [Environmental]).



Bureau of Water, City of Chicago

City Drinking Water Is Examined for Impurities.

SANITATION is a field of public health. It involves man's efforts to control his environment to prevent and control disease. Sanitation also includes personal cleanliness, which helps protect against disease.

In the United States, many professions and various government agencies work together to protect the health of communities. Sanitary engineers are chiefly responsible for designing and administering such projects as water treatment plants and sewage treatment plants. Government agencies establish and enforce laws that help promote a healthful environment.

Sanitation activities include food processing and distribution, sewage treatment, solid waste disposal, water treatment, and numerous other measures, such as control of air pollution and rodents.

Food Processing and Distribution. Food and beverages can easily be contaminated by bacteria, viruses, worms, and other organisms and by chemical poisons. In the United States, many agencies are involved in food and beverage control. For example, the U.S. Department of Agriculture inspects meat before and after animals are slaughtered. Its investigators also check the processing, labeling, packaging, and distribution of food. The Public Health Service provides communities with model laws that recommend requirements for producing, processing, and handling food. One such law deals with pasteurization of milk and milk products. See PURE FOOD AND DRUG LAWS (Foods); MEAT PACKING (U.S. Government Inspection).

Sewage Treatment. Sewage is water containing waste matter produced by man. It contains about a tenth of 1 per cent solid waste. It comes from sinks and toilets in homes, farms, restaurants, factories, and office buildings. Much industrial sewage contains harmful chemicals and other waste materials.

Sewage must be treated before it flows from sewerage systems into lakes, rivers, and other bodies of water. Untreated sewage contaminates the water and, in time, can kill fish and aquatic plants. The sewage makes the water unsafe to drink and can also prevent use of the water for swimming, fishing, and other recreation.

Most cities and towns in the United States have at least one sewage treatment plant. In most rural areas, homeowners must provide their own sewage treatment. Most rural homeowners do so with large underground containers called *septic tanks*.

For more detailed information on sewage treatment, see the WORLD BOOK article on SEWAGE.

Solid Waste Disposal has become a major sanitation problem. Solid waste, which is also called *refuse*, consists of garbage and trash from cities and towns, plus by-products of farming, mining, and manufacturing. Such by-products include animal carcasses and manure from farms, sawdust and scrap metal from factories, and pieces of coal and various metals from mines.

Almost all methods of solid waste disposal can create environmental problems. For example, open dumps look unpleasant and may be foul smelling. They also provide homes for rats and other animals that carry disease. Burning solid waste causes smoke, which makes the air dirty. But when land disposal sites and incinerators are properly operated, they cause little harm to the environment. See WASTE DISPOSAL.

Water Treatment. Most water must be treated before man uses it for drinking, cooking, bathing, or laundering. Almost all untreated water contains bacteria, viruses, and other tiny organisms. It also may have an unpleasant odor and taste and contain minerals that make the water less useful as a cleaning agent.

Cities and towns obtain water from one of two sources: (1) the ground or (2) rivers and lakes. Most U.S. communities of fewer than 5,000 persons get their water from the ground. Such water requires little treatment. Most of the larger cities get their water from rivers and lakes for various reasons. In many cities, for example, there is not enough water in the ground to supply the large population. Water from rivers and lakes is piped from its source to a treatment plant, where chemical and physical processes purify it. Pipes under the streets distribute the water to houses and other buildings.

Other Sanitation Activities. Most communities have regulations that require dwellings, factories, hospitals, and recreation areas to meet certain sanitary standards. Sanitation also includes insect and rodent control,

Meat Must Be Inspected Before It Can Be Marketed.

U.S. Dept. of Agriculture

noise control, and licensing of operators of public facilities. HARVEY WILKE

See also ENVIRONMENTAL POLLUTION; PUBLIC HEALTH; WATER (City Water Systems).

SANS-CULOTTE, *SANZ kyoo LAHT*, is a French word that means *without breeches*. It refers to the French workers who wore long trousers at the time of the French Revolution (1789-1799). The aristocrats, against whom they had rebelled, wore knee-length breeches.

SANSKRIT LANGUAGE AND LITERATURE originated in ancient India. The Sanskrit language is divided into two periods. Old Sanskrit is the language in which the holy *Vedas*, sacred Hindu books, were written. Old Sanskrit is also called *Vedic Sanskrit*, or simply *Vedic*. Most writings of the second, or classical, period deal with nonreligious subjects.

It is not definitely known when Sanskrit was introduced into India, but 1500 B.C. is the date generally accepted. For a period, Sanskrit was both the common speech and the literary language. But by the 500's B.C., local dialects had sprung up. Buddha preached his doctrine in one of these. Pāṇini (300's B.C.) was the first and greatest Indian grammarian. He fixed the characteristics of *Sanskrit* ("purified, cultivated") in contrast with the common spoken language *Prakrit* ("natural, unpurified").

Om is a sacred syllable in the Sanskrit language, similar in meaning to the English *amen*. It might well be translated, *So it shall be*. It was to be uttered at the start and close of every Vedic recitation to ensure that the understanding of what was spoken should not be lost. Later, the syllable referred to the Hindu Trinity of Vishnu, Brahma, and Shiva. The syllable symbolized the abstract unity of the universe: Absolute (a) and Relative (u) are related (m). The three letters, *a-u-m*, are pronounced *om*.

The Sanskrit Language became widely known to Europeans in the late 1700's. Franz Bopp (1791-1867) and other linguists used it to develop the comparative study of languages (see LINGUISTICS). Many words in the Greek, Latin, English, German, Persian, and other languages are also found in Sanskrit. The Sanskrit word *mata* became *mater* in Latin, *Mutter* in German, and *mother* in English. The English words *brother*, *sister*, *daughter*, and *son* are related to the Sanskrit *bhrātā*, *svasr*, *duhita*, and *sunu*. Scholars study the *Rig-Veda* to compare it with the myths and religions of other lands.

Sanskrit Literature began with the *Vedas*. They constitute the oldest work in any Indo-European language. The works of the Vedic period are religious and were long transmitted orally. They consist of the *Rig-Veda* (about 1000 B.C.), the *Sama-Veda*, the *Yajur-Veda*, and the *Atharva-Veda*.

In its second, or classical, period the literature was mostly secular, or nonsacred. The outstanding epics are the *Mahabharata* (200 B.C.?) and the *Ramayana*. Dramas were produced in India as early as in the Western world, first appearing in the 400's B.C. The author Kalidasa appears to be India's Shakespeare. There are also lyric and instructive poems, the Hindu legal code called the *Code of Manu*, and philosophical works of various schools, such as the *Vedanta*, *Sankhya*, and *Yoga*. India's chief contributions to Western literature are in the fields of fiction and fable. Indian fairy-tale motifs appear in the *Arabian Nights* and in medieval legends and stories. The *Panchatantra* is the chief Sanskrit collection of fables. FRANZ ROSENTHAL

See also HINDI; MAHABHARATA; RAMAYANA; VEDAS.

[a] काकौ वृक्षे वसतः [b] देवो वदति
[c] किमर्थम्पितरम्पुत्रो न स्मरति

Sanskrit was the language spoken in India about 3,000 years ago. Translated, these Sanskrit sentences mean: (a) Two crows dwell in a tree; (b) The God speaks; (c) Why does the son not remember the father?

SANTA ANA, Calif. (pop. 155,762), is the chief trading center of the rich farm area of Orange County. With nearby Anaheim and Garden Grove, it forms a metropolitan area with a population of 1,421,233. Santa Ana lies about 33 miles (53 kilometers) southeast of Los Angeles (see CALIFORNIA [political map]).

The city's 180 factories manufacture a wide variety of products, ranging from electronic components to bowling balls. The surrounding farming region produces oranges, beef cattle, green beans, celery, sugar beets, peppers, and pimentos. Railroad passenger trains and two freight lines serve the city. Santa Ana also has an airport and two heliports.

Santa Ana was established in 1869 and incorporated in 1886. It is the seat of Orange County, and has a council-manager government. GEORGE SHAFTEL

SANTA ANA, *SAHN tah AH nah* (pop. 109,344), is the second largest city in El Salvador. It is an important commercial center, especially for the exporting of coffee. Other important industrial activities in Santa Ana include sugar milling, brewing, and the manufacture of cotton textiles, footwear, and furniture. Santa Ana also has a national theater and an art school. For the location of Santa Ana, see EL SALVADOR (map).

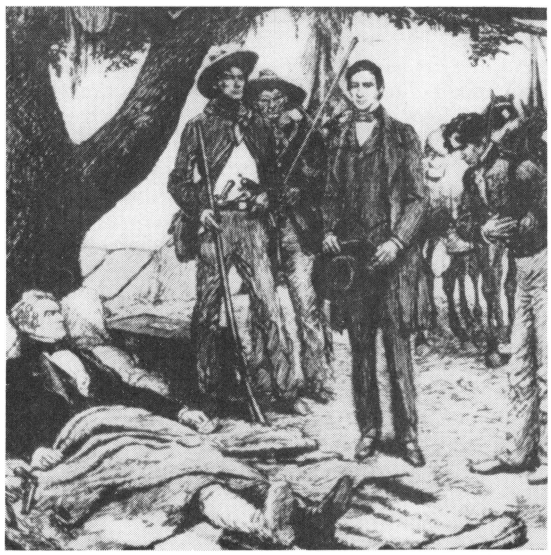
SANTA ANNA, *SAHN tah AH nah*, **ANTONIO LÓPEZ DE** (1795-1876), was a Mexican soldier and politician. He ruled Mexico three times as a dictator-president, but he was always overthrown.

Young Soldier. Santa Anna was born in Jalapa, in the province of Veracruz, on Feb. 21, 1795. At 15, he became a cadet in the Spanish Army stationed in Mexico. He began his long career by fighting against the Mexicans in the War of Independence. Toward the end of the war, he deserted the Spaniards and joined forces with Agustín de Iturbide, who won and declared himself emperor of Mexico (see ITURBIDE, AGUSTÍN DE).

Santa Anna expected the new emperor to make him governor of Veracruz. When Iturbide failed to do so, Santa Anna led a revolt against him and drove him from power. In 1829, Spain attempted to reconquer Mexico. Santa Anna, as commander in chief of the Mexican Army, won several victories, and the Spanish invasion was defeated. He was elected president in 1832. He did

Ayer Coll., Newberry Library

Santa Anna



Bettmann Archive

Santa Anna was captured during the Texas victory at San Jacinto, and brought before Gen. Sam Houston on April 23, 1836.

not serve until 1834, when he seized control of the government and assumed dictatorial powers.

War With Texas. Santa Anna had little regard for the law. He abolished the federal constitution and placed the governors of provinces under his own control. These acts caused a revolt in Texas, a part of Mexico which had been settled by persons from the United States.

Santa Anna rushed north to put down the revolt. He attacked San Antonio and stormed the Alamo in March, 1836, with a great army that outnumbered the Texans 30 to 1. All the Texas troops were slain (see ALAMO). Then Santa Anna met the main Texas army under General Sam Houston at San Jacinto. Santa Anna's army was routed, and he was taken prisoner. The Texans forced him to sign a treaty acknowledging the independence of Texas. But the treaty was rejected in Mexico City, and Santa Anna was removed from power.

The American War. In 1838, the French attacked Veracruz. Santa Anna took command of the defending troops and beat back the attackers. From 1841 to 1844, he was president of Mexico again. In 1844, there was a revolt against him, and he fled to Jamaica. War broke out with the United States in 1846. Santa Anna returned to Mexico and took command of the army. The American forces defeated him at Buena Vista, at Cerro Gordo, and at Chapultepec. After the fall of Mexico City, Santa Anna left Mexico for several years.

In 1853, he returned to Mexico and became president again. He declared himself president for life, but within two years was again overthrown and exiled. He tried to return during the French invasion of Mexico in 1864, but was not allowed to enter the country. He returned in 1874 after the death of President Benito Juárez, and died in poverty in Mexico City. DONALD E. WORCESTER

See also MEXICAN WAR.

SANTA BARBARA, Calif. (pop. 70,215; met. area 264,324), is an old Spanish mission town. It lies on the Pacific Coast, 98 miles (158 kilometers) northwest of Los Angeles (see CALIFORNIA [political map]).

Santa Barbara preserves much of its Spanish background. Its mission is sometimes called the "Queen of the California Missions." Many visitors come to Santa Barbara during the "Old Spanish Days," which are held every August. Electronics research and development and tourism are major sources of income.

A large campus of the University of California is in Santa Barbara. The city is also the home of Westmont College and of Brooks Institute.

Father Junípero Serra and Captain José Francisco de Ortega founded Santa Barbara in 1782. It was incorporated as a city in 1850. The city is the seat of Santa Barbara County, and has a mayor-council form of government. GEORGE SHAFTEL

SANTA CATALINA. See CATALINA ISLAND.

SANTA CLARA, Calif. (pop. 87,717), is a rapidly growing city 45 miles (72 kilometers) southeast of San Francisco. Food processing is the main industry. The city was founded as a Franciscan mission in 1777, and incorporated in 1866. It has a council-manager government. For location, see CALIFORNIA (political map).

SANTA CLAUS is a mythical old man who brings gifts to children at Christmas. Today's Santa Claus developed from a real person, Saint Nicholas, who lived in the A.D. 300's. He was bishop of Myra, an ancient town of Lycia, now in Turkey. According to legend, he was only a boy when he became a bishop. He was extremely kind, and often went out at night, taking presents to the needy. After his death, his fame spread throughout Europe. During the Middle Ages, Saint Nicholas became the patron saint of schoolboys. Schoolboys in various European towns celebrated his feast day on December 6 by electing a boy-bishop. Dressed in magnificent robes, the boy-bishop led a parade through the streets. There was much feasting, but on the whole the occasion was solemn. Later, this custom died out, but Nicholas remained the favorite saint with children.

In The Netherlands, both young and old still celebrate his feast day. A person representing Saint Nicholas rides through the streets on a white horse. In Germany, Nicholas sometimes appears as a hairy imp, *Pelz Nichol,* meaning *Nicholas in Fur.* Parents tell Pelz Nichol how their children have behaved during the year. Then good children are rewarded with presents, while bad boys and girls receive only a bundle of twigs or switches.

Children were so fond of Saint Nicholas and his habit of bringing gifts that the custom of celebrating his feast day was maintained. Dutch settlers brought the custom with them to New Amsterdam (now New York City), and English settlers eagerly borrowed the legends and festivities surrounding the kindly Saint Nicholas. English-speaking children tried to pronounce the Dutch name for the saint, *Sinterklaas.* But they said it quickly and excitedly, and soon the name changed to *Santy Claus* or *Santa Claus.*

Appearance. Santa's appearance began to change about the same time as his name. For hundreds of years, Europeans had imagined Saint Nicholas as a tall, thin, stately person. But Washington Irving created a new picture of him as a fellow who looked very much like a typical Dutch settler in the state of New York. In his *Knickerbocker's History of New York* (1809), Irving described the saint as the guardian of New York City. He

Harold M. Lambert

Jovial and Kindly Santa Claus reads a letter from a young admirer, before starting on his Christmas rounds.

pictured him as a jolly fellow wearing a broad-brimmed hat and huge breeches and smoking a long pipe. Irving's Saint Nicholas rode over the treetops in a wagon, and dropped presents from his pockets down chimneys.

In 1822, Clement C. Moore wrote for his children the poem "A Visit from St. Nicholas," which describes the saint more as we know him today (see MOORE, CLEMENT C.). In this poem, which begins with the familiar line "'Twas the night before Christmas," the saint is pictured as a round and jolly figure with twinkling eyes, a "nose like a cherry," and a white beard. He puffs a stump of a pipe and rides in a sleigh pulled by eight reindeer. Like the German *Pelz Nichol*, "he was dressed all in fur, his head to his foot." In 1837, a painting by Robert W. Weir showed Santa as a friendly, tubby fellow, wearing a hood and knee boots, and carrying a bag of toys. He was grinning and, in Moore's words, "laying his finger aside of his nose."

Thomas Nast, the famous American cartoonist, further developed the figure of Santa Claus in a cartoon in 1863. Later, his famous drawing "Santa Claus and His Works," which appeared as a Christmas picture in *Harper's Weekly* in 1866, showed Santa Claus in his workshop with his record of the good and bad deeds of all children. The drawing also showed the reindeer-drawn sleigh, the pack of toys, the stockings hung at the fireplace, and the Christmas tree.

Festivities. For hundreds of years, people celebrated the feast of Saint Nicholas on December 6, which is the anniversary of the saint's death. After the Protestant Reformation, Saint Nicholas was replaced by the Christ Child, called *Christkindl* or *Christkindli*, in parts of Germany and in parts of Switzerland. From this name came the character *Kris Kringle*, the angel-like figure who brings gifts at Christmastime. Sometimes Pelz Nichol accompanies him.

In England, Saint Nicholas Day festivities were banned when Henry VIII founded the Church of England. They were later resumed when Queen Victoria married a German prince, Albert. Then Saint Nicholas returned as Father Christmas, a gentleman dressed in a long tail coat and square beaver hat. He, too, appeared at Christmastime. But in many European countries, such as The Netherlands, Belgium, Austria, and parts of Germany and Switzerland, Saint Nicholas celebrations still take place on December 6.

In the United States, Santa Claus' activities always occur at Christmastime. The American version of Santa Claus has also become popular in Canada, England, and Australia as a person who brings presents and Christmas cheer. ARTHUR M. SELVI

See also CHRISTMAS; NICHOLAS, SAINT.

SANTA CLAUS, Ind. (pop. 63), is about 10 miles (16 kilometers) north of the Ohio River, and 30 miles (48 kilometers) northeast of Evansville, Ind. Every December, thousands of letters addressed to "Dear Santa Claus" pour into this Indiana town. In a typical year, close to four million pieces of mail may come from everywhere to be remailed with the magic postmark. A small park in the town has a statue of Santa Claus dedicated to "The Children of the World." See also INDIANA (Places to Visit). PAUL E. MILLION, JR.

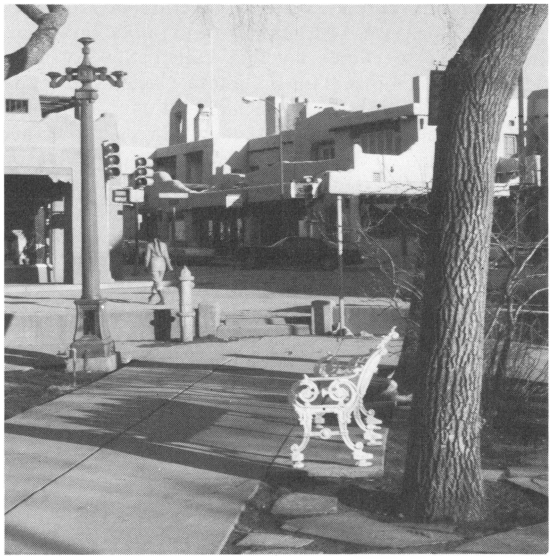
SANTA CRUZ, ANDRÉS. See BOLIVIA (Independence).

SANTA CRUZ ISLANDS lie in the Pacific Ocean about 1,800 miles (2,900 kilometers) northeast of Sydney, Australia. They have a population of 9,078 and cover 323 square miles (837 square kilometers). The Santa Cruz island group is east of the Solomon Islands. It is administered as part of the same British Protectorate as the Solomon Islands. The chief islands are Ndeni (or Santa Cruz), Utupua, and Vanikoro. The islands are in Melanesia, but many of the people are of Polynesian ancestry. EDWIN H. BRYAN, JR.

SANTA FE, *sahn tah FAY* (pop. 244,579), is a shipping center in east-central Argentina. On the upper Paraná River, it has facilities for ocean shipping (see ARGENTINA [political map]). Milling and the making of quebracho extract are its main industries.

SANTA FE, N.Mex. (pop. 41,167), is the capital of the state. It has served as a seat of government longer than any other state capital in the United States. Santa Fe was founded as the capital of the Spanish province of New Mexico in 1610. Santa Fe lies in north-central New Mexico. The city is about 6,950 feet (2,118 meters) above sea level in the Sangre de Cristo Mountains (see NEW MEXICO [political map]).

Santa Fe's major industry is the tourist trade. The Museum of New Mexico has several buildings in Santa Fe, including the Museum of International Folk Art, the Hall of the Modern Indian, and the Laboratory of Anthropology. The Museum of Navaho Ceremonial Art is also popular. The San Miguel Mission in Santa Fe, built about 1710, is one of the oldest mission churches in the United States. A campus of Saint John's College (Md.) and the College of Santa Fe are located



WORLD BOOK photo by Robert H. Martin

La Fonda Hotel in Santa Fe, N.Mex., *background,* **is on the site of an old inn that marked the end of the Santa Fe Trail.**

there. Santa Fe has a council-manager government, and is the seat of Santa Fe County. FRANK D. REEVE

See also NEW MEXICO (picture: The State Capitol).

SANTA FE DAM is a flood control project on the San Gabriel River, about 29 miles (47 kilometers) above its mouth in southern California. It is a rolled earth-fill dam, designed to hold back 35,800 acre-feet (44,160,000 cubic meters) of water. It is 92 feet (28 meters) high, and 24,100 feet (7,346 meters) long. T. W. MERMEL

SANTA FE RAILROAD. See RAILROAD (The 1920's and the Great Depression; The Railroad Industry).

SANTA FE TRAIL was one of the longest commercial routes in the United States in the prerailroad era. It began in Independence, Mo., and ended in Santa Fe, N.Mex., a distance of 780 miles (1,260 kilometers). Caravans of traders traveled to Council Grove, Kans., and on to the Cimarron Crossing of the Arkansas River near Cimarron, Kans. There the route divided. One branch led up the Arkansas to Bent's Fort (near La Junta, Colo.), then turned southwest across Raton Pass to the upper Canadian River in New Mexico. The other route cut across the Cimarron Desert. This one was shorter, but Indians made it more dangerous.

The early travelers transported their goods by pack horses. William Becknell first used the Santa Fe Trail in 1821. After that, traders took wagons loaded with manufactured goods to Santa Fe to exchange for mules, furs, gold, and silver. Between 1822 and 1843, an average of about 80 wagons and 150 men used the trail each year. Travel westward increased greatly during the 1850's and 1860's. By the late 1860's, more than 5,000 wagons a year used the trail. An extension of the trail, known as *The Old Spanish Trail*, ran from Santa Fe to Los Angeles by way of Durango, Colo., the Green and Virgin rivers in Utah, the Colorado River, and across the Mojave Desert in California. W. TURRENTINE JACKSON

See also TRAILS OF EARLY DAYS (map).

SANTA GERTRUDIS. See CATTLE (The Santa Gertrudis; color picture).

SANTA ISABEL. See CIUDAD DE MALABO.

SANTA MARÍA. See COLUMBUS, CHRISTOPHER (First Voyage to America; picture); CARAVEL.

SANTA MARTA (pop. 149,755), is a seaport near the northern tip of Colombia. For location, see COLOMBIA (color map). The city is important as a banana-shipping center. Many years ago it was the point from which adventurers started in search of El Dorado. Santa Marta was founded in 1525 by Rodrigo de Bastidas, a Spanish navigator and explorer. It is the oldest permanent settlement in South America. Nearby is the *hacienda* (estate) of San Pedro Alejandrino, where the South American liberator Simón Bolívar spent his last days. See also EL DORADO.

SANTA MONICA, Calif. (pop. 88,289), is a city and beach resort about 15 miles (24 kilometers) west of Los Angeles, on crescent-shaped Santa Monica Bay. For location, see CALIFORNIA (political map).

The city was probably named by Father Crespi, a Spanish missionary who camped on the site on Saint Monica's Day in 1769. The McDonnell Douglas Corporation, a large aircraft company, is in the city. Pacific Ocean Park, a beach amusement center there, is often called the *Coney Island of the West*. Santa Monica was incorporated in 1886, and has a council-manager government. GEORGE SHAFTEL

SANTA ROSA ISLAND is a long, narrow island outside Pensacola Bay off the northwestern Florida coast. Santa Rosa Sound separates the island from the mainland. Santa Rosa Island is about 50 miles (80 kilometers) long (from east to west) and averages about 1 mile (1.6 kilometers) in width. Its area is 49 square miles (127 square kilometers). The island is a popular residential and resort area. Fort Pickens Military Reservation, an important post during the Civil War, stands on the western end. In the 1870's, the fort became a military prison. It served as a coastal defense center in the Spanish-American War and in World Wars I and II. See also FORT PICKENS. KATHRYN ABBEY HANNA

SANTANDER, *SAHN tahn DAIR,* **FRANCISCO DE PAULA** (1792-1840), was a South American soldier and statesman. From 1822 to 1827, he governed New Granada (now Colombia) as acting president while Simón Bolívar was absent. Later, as president from 1832 to 1837, he encouraged national industry, built up a trained army, and established schools and courts.

Santander was born in Cúcuta. He studied law in Bogotá, but enlisted at 18 in the revolutionary army. At 25, he was promoted to the rank of full general. In 1828, he was exiled for political reasons, but returned after Bolívar's death. DONALD E. WORCESTER

SANTAYANA, *SAHN tah YAH nah,* **GEORGE** (1863-1952), was a philosopher and author. He was born in Spain but grew up in the United States and spent about half his life there. Santayana expressed his philosophy not only in technical works but also in dialogues, literary essays, sonnets, and a popular novel, *The Last Puritan* (1936).

Santayana's philosophy puzzles many readers. He developed a theory of reality that centered on the distinction between *essences* and *existence*. Santayana defined essences as ideas, meanings, perceptions, and possibilities. In contrast, the world of existence includes

the events, persons, and things that we encounter in life. Santayana believed that not all essences actually exist, but that every existing thing includes essences. The role of essences, according to Santayana, is to describe and illuminate existence.

Santayana regarded religion as a kind of poetry expressing imaginative ideals that give spiritual meaning to life. But he said religion must not be taken literally. Santayana wrote that men must believe in an ideal world where the human spirit can be creative and free. However, this ideal world must not be mistaken for reality.

Santayana wrote an enormous number of works on art, morality, religion, and science. His *Three Philosophical Poets* (1910) consists of interpretations of Dante Alighieri, Lucretius, and Johann von Goethe. *Character and Opinion in the United States* (1920) is a commentary on American life. Santayana's other well-known books include *The Sense of Beauty* (1896), *Interpretations of Religion and Poetry* (1900), *The Life of Reason* (five volumes, 1905-1906), *Scepticism and Animal Faith* (1923), and *Realms of Being* (four volumes, 1927-1940).

Santayana was born in Madrid. His family moved to the United States in 1872 and settled in Boston. Santayana graduated from Harvard University in 1886. He taught philosophy at Harvard from 1889 to 1912, when he settled permanently in Europe. JOHN E. SMITH

SANTEE-COOPER PROJECT is an electric-power and navigation development 36 miles (58 kilometers) north of Charleston, S.C. The project consists of two dams. The Santee Dam, $7\frac{1}{2}$ miles (12 kilometers) long, forms Lake Marion. Pinopolis Dam and Dikes, about 28 miles (45 kilometers) long, forms Lake Moultrie. The two lakes are connected by a diversion canal $7\frac{1}{2}$ miles (12 kilometers) long. This canal turns the waters of Lake Marion into Lake Moultrie, through an electric powerhouse, and then through the Tailrace Canal into the Cooper River. The $57 million Santee-Cooper Project was built by the South Carolina Public Service Authority. The project was started in 1938 and went into operation in 1941. T. W. MERMEL

SANTEE RIVER. See SOUTH CAROLINA (Rivers).

SANTERÍA. See CUBA (Religion).

SANTIAGO (pop. 2,661,920), is the capital and largest city of Chile. It is the nation's cultural, economic, and transportation center. Santiago lies in the center of Chile, about 90 miles (144 kilometers) east of the Pacific Ocean (see CHILE [political map]). The promise of rich farmland and mineral deposits first attracted settlers to the area during the 1500's. Today, Santiago is an attractive city characterized by colonial architecture, wide boulevards, and hillside parks.

The City. Santiago lies in the fertile Central Valley, the agricultural heartland of Chile. Mountains and hills surround the city. The Andes Mountains, the highest range in South America, rise above Santiago to the east. Many of these peaks remain snow-capped the year around, adding to the city's scenic beauty. The Pacific coastal range forms Santiago's western border.

A square called the Plaza de Armas forms the heart of downtown Santiago. The Cathedral of Santiago, City Hall, and many shops stand on the plaza. The congressional building and other federal government structures are a few blocks west. Monuments and public buildings line a wide tree-lined avenue called the Avenida Bernardo O'Higgins. The Biblioteca Nacional in Santiago ranks as South America's largest library. It owns a collection of more than 1,200,000 volumes. Other attractions include the Civic Center, the Museum of Natural History, and the Municipal Theater, the home of Santiago's two symphony orchestras. The Catholic University of Chile, the Technical University, and the University of Chile are also in Santiago. Parks landscaped with gardens and memorial statues dot the city's hillsides.

The People. Most of Santiago's people have Spanish ancestry, though some are of French, German, or Italian descent. Many of the people are *mestizos* (persons of mixed white and Indian ancestry). About 95 per cent of the city's population are Roman Catholics.

The people of Santiago live and dress much like city dwellers in the United States, Canada, and Europe. Wealthy and middle-class families live in spacious homes with landscaped courtyards in suburban areas. Their meals often feature such seafood as eel, shrimp, swordfish, or tuna, and they usually serve wine.

Poor people make up about a fourth of Santiago's population. A large number of them live in shantytowns called *callampas*, and their meals are based on beans, bread, and vegetables. Many of the poor suffer from various illnesses because they lack adequate food and housing.

Economy. Santiago is the home of Chile's stock exchange and major banks. The government-owned railroad system and parts of the coal, copper, and steel industries have their headquarters in the city. Many of the people work for the federal or city government. Others work in factories that manufacture household appliances, textiles, or other products.

Jerry Frank, DPI

In Santiago, Chile, historic structures stand among modern hotels and office buildings. Numerous parks add to the city's beauty.

Santiago is the center of the Chilean railroad network, which covers about two-thirds of the country. Buses and trolleys provide local public transportation.

History. Araucanian Indians lived in what is now the Santiago area when Europeans arrived there in the early 1500's. A Spanish soldier named Pedro de Valdivia founded Santiago in 1541. It was the first permanent Spanish settlement in what is now Chile. In the late 1500's, Santiago became the seat of Spanish rule over the Chilean region and parts of Argentina. Santiago became the capital of Chile in 1818, the year in which the nation gained independence.

In 1879, Chile won lands rich in copper and nitrates by defeating Bolivia and Peru in the War of the Pacific. Santiago grew rapidly as a result of this new mineral wealth. By the early 1900's, the city had about a million people and was a cultural center of Latin America. Santiago's economy expanded during World War I (1914-1918) because of the demand for nitrates used in making explosives. After World War II ended in 1945, Santiago became a center of Chile's industrial expansion. The population of the city grew about twice as fast as that of the rest of Chile.

During the mid-1970's, the Chilean government planned a program to clear land in Santiago for the construction of high-rise office and apartment buildings. Several sections of the METRO, the city's new subway, were completed in 1975. KALMAN H. SILVERT

See also CHILE (pictures).

SANTIAGO (pop. 103,861), also called SANTIAGO DE LOS CABALLEROS, is the second largest city in the Dominican Republic. It lies on the Yaque del Norte River, 85 miles (137 kilometers) northwest of Santo Domingo (see DOMINICAN REPUBLIC [map]). Santiago is a trading center for cacao, rice, and tobacco. THOMAS G. MATHEWS

SANTIAGO, BATTLE OF. See SPANISH-AMERICAN WAR (Chief Events).

SANTIAGO CONFERENCE. See PAN-AMERICAN CONFERENCES.

SANTIAGO DE CUBA, *sahn TYAH goh day KOO bah* (pop. 275,970), lies at the foot of the Sierra Maestra range on the southeast coast of Cuba. It is 460 miles (740 kilometers) southeast of Havana. For location, see CUBA (color map). Santiago serves as the center of Cuba's mining industry. It is a shipping center for iron, manganese, sugar, coffee, and tobacco. Morro Castle, one of its landmarks, was built to defend its harbor from British and French pirates. In 1898, during the Spanish-American War, a United States fleet destroyed most of the Spanish fleet near Santiago harbor. OTIS P. STARKEY

SANTO DOMINGO, *SAHN toh doh MING goh* (pop. 654,757), is the capital and largest city of the Dominican Republic. It lies at the mouth of the Ozama River on the southern coast (see DOMINICAN REPUBLIC [map]). The city is an important seaport and airport. Its factories produce sugar products, textiles, and liquor. Resort hotels and beaches make it a popular tourist spot.

Santo Domingo is the oldest European-founded city in the Western Hemisphere. Bartholomew Columbus, a brother of Christopher Columbus, founded it in 1496 as *Nueva Isabela.* The Cathedral of Santo Domingo, completed about 1540, is the oldest church in the West Indies. Some historians say it holds Christopher Columbus' tomb.

A hurricane destroyed most of the city in 1930. It was rebuilt along modern lines, but many of its buildings are in the Spanish colonial style. An impressive example is the Alcazar, the rebuilt palace of Viceroy Diego Columbus, Christopher's son. From 1936 to 1961, under dictator Rafael Trujillo, the city was called CIUDAD TRUJILLO. THOMAS G. MATHEWS

See also DOMINICAN REPUBLIC (picture).

SANTO DOMINGO, UNIVERSITY OF, in Santo Domingo, Dominican Republic, is the oldest university in the Western Hemisphere. It was established by Pope Paul III in 1538 as the University of Saint Thomas Aquinas. The Dominican Order of Preachers operated the school, granting degrees to lay students as well as the clergy. The university became a lay institution in 1815. The university offers programs in agronomy, architecture, business, engineering, law, medicine, philosophy, and veterinary medicine. It has an enrollment of about 3,800. EMILE DELAVENAY

SANTOS, *SAN tus* (pop. 345,459), is the port for the city of São Paulo, Brazil. It lies on the Atlantic Ocean about 200 miles (320 kilometers) southwest of Rio de Janeiro (see BRAZIL [political map]). Santos is the greatest coffee-shipping port in Brazil. It was founded between 1532 and 1536. MANOEL CARDOZO

SANTOS-DUMONT, ALBERTO (1873-1932), was an aviation pioneer in both lighter-than-air and heavier-than-air machines. He used his wealth to promote aviation and to help promising inventors.

Santos-Dumont was born in Brazil of wealthy parents, and was educated mostly in France. In 1898, he flew a cigar-shaped gas bag propelled by two small engines driving a single propeller. He built a box-kite airplane in 1905. Each wing was a box-kite, and a third box-kite was suspended ahead of the aircraft to provide control. In 1906, he flew it for eight seconds in the first heavier-than-air flight in France. The main advantage of the box-kite construction was its light weight, about half that of the first Wright brothers' biplane. One of his most lasting contributions was the use of wheeled undercarriages. ROBERT B. HOTZ

See also AIRPLANE (Other Pioneer Planes and Fliers; picture: The Demoiselle).

SÃO FRANCISCO, RIO, *sown fran SEESH koo*, also called SAN FRANCISCO, RIO, is a river of eastern Brazil. It rises in the state of Minas Gerais. It flows northeast, then eastward, to form the boundary between the states of Bahia and Pernambuco. Then the river turns to the southeast, and empties into the Atlantic Ocean, 1,988 miles (3,199 kilometers) from its source. As it leaves the mountains in Minas Gerais, it plunges over falls and rapids. Then it is a broad, navigable stream for 1,000 miles (1,600 kilometers) of its middle course. But 200 miles (320 kilometers) from the Atlantic, it again becomes swift and rocky as it tumbles over rapids and a magnificent falls called Paulo Afonso. See also RIVER (chart: Longest Rivers). MARGUERITE UTTLEY

SÃO MIGUEL ISLAND, *sown me GEHL*, is the largest island of the Azores. It covers 292 square miles (756 square kilometers) and has a population of about 150,000. Ponta Delgada is the chief city (see PONTA DELGADA). The island produces cereals, fruits, potatoes, tea, tobacco, and wine.

World Photo Service from Madeline Grimoldi

São Paulo, Brazil, is the largest city in South America and the fastest growing city in the world. Hundreds of modern buildings crowd the busy downtown section, *left.* Such spacious recreation areas as Ibirapuera Park, *above,* offer a striking contrast to the noise and congestion of the central city.

SÃO PAULO, *sown POW loo* (pop. 5,241,232; met. area 8,062,130), is Brazil's largest city and leading commercial and industrial center. It is also the largest city of South America. São Paulo, the capital of the state of São Paulo, lies in southeastern Brazil, about 240 miles (386 kilometers) from Rio de Janeiro. For location, see BRAZIL (political map).

In 1554, Jesuit missionaries from Portugal founded São Paulo as an Indian mission. São Paulo remained a small town until the mid-1800's, when it became the commercial center of Brazil's booming coffee industry. Thousands of Asians and Europeans came to São Paulo State to work on the coffee plantations, and many of them later moved to São Paulo City. In time, the plantation owners invested much of their profits in industries in São Paulo. Today, the city and its surrounding area account for about half of Brazil's total industrial output. During the 1970's, São Paulo ranked as one of the fastest-growing major cities in the world in terms of population.

The City lies on a high plateau about 30 miles (48 kilometers) from the Atlantic Ocean. A steep slope separates São Paulo from the coastal city of Santos, to the southeast. Santos serves as São Paulo's port (see SANTOS). São Paulo covers 627 square miles (1,624 square kilometers), and its metropolitan area occupies 2,191 square miles (5,674 square kilometers). The Tietê and Pinheiros rivers flow through the city.

Wide avenues and unusually designed skyscrapers give the city a modern appearance. Few of São Paulo's buildings are even 100 years old, though a chapel built in 1554 and a few old churches still stand. The center of the business district is an area called the Triangle. This name dates back to the 1500's, when paths connecting three mission buildings formed a triangle there.

Many hotels and restaurants are northwest of the Triangle. A public square called the Plaza of the Republic features an arts and crafts market each Sunday in this area. Mansions once lined Paulista Avenue, southwest of the Triangle, but most have been replaced by skyscrapers. Apartment and office buildings also have taken the place of homes in other areas. Many residents have moved to the suburbs.

São Paulo has a number of parks, the largest of which is the beautifully landscaped Ibirapuera Park. A monument to the *bandeirantes* (pioneers) of São Paulo stands at the entrance to the park. The nearby Santo Amaro lake region is a popular recreation area. Sports events are held at Morumbi and Pacaembu stadiums.

São Paulo faces many problems associated with a rapid population growth. For example, many homes have neither running water nor sewerage service. Other problems include air pollution, overcrowding, and traffic congestion. In an attempt to solve some of its problems, the city started several water and sewerage improvement projects during the early 1970's. Construction of commercial and recreational facilities outside the central part of the city helped relieve the overcrowding. A rapid transit system opened in 1974.

People of São Paulo are called *Paulistas.* Most of them have ancestors who immigrated from Germany, Italy, Japan, Lebanon, Portugal, Spain, or Syria. Some Paulistas have African or American Indian ancestry. Since the 1930's, immigration from other countries to São Paulo has decreased. At the same time, migration from other areas of Brazil to São Paulo has increased.

About 350,000 Brazilians move to São Paulo annually. They are attracted to the city largely because it has more jobs and higher wages than other areas of Brazil.

Paulistas speak a variety of languages, but most of them also speak Portuguese, Brazil's official language. Most of the people are Roman Catholics, but many Paulistas belong to local religious groups as well. Some of these groups worship African gods.

Paulistas have the reputation of being the most energetic, hard-working people in Brazil. But they also like to relax. After a morning at their job, many people eat a leisurely lunch and then rest until late afternoon before returning to work. Paulistas enjoy sports, especially soccer. They celebrate the founding of São Paulo on January 25 and All Saints' Day on November 1, in addition to national holidays.

Poverty is a serious problem in São Paulo despite the city's prosperity. More than half the families have a monthly income of less than $150. Many of these families live in slum areas called *cortiços*, which consist of many shacks jammed together. The large-scale migration to the city intensifies the problem of poverty. Most of the people who move to São Paulo lack job skills, and many cannot find employment there. The city has made some progress in providing job training and adequate low-cost housing for these people.

Education and Cultural Life. The University of São Paulo, which has about 28,000 students, is the largest university in Brazil. The city also is the home of Holy Catholic and Mackenzie universities. In addition, São Paulo has a college of medicine, a college of political science, and several fine-arts schools.

São Paulo's Municipal Library ranks as one of the largest public libraries in South America. The city also has a fine system of children's libraries. São Paulo's museums include institutions of art, folklore, forestry, history, Indian culture, and zoology. A scientific center, the Butantan Institute, became known for its development of snakebite serums.

São Paulo has sponsored an international art show called the *Bienal* every other year since 1951. Theaters present ballet, opera, symphony concerts, and plays.

Economy. About 40 per cent of São Paulo's workers have a job in construction or manufacturing. The city produces more than half of Brazil's chemicals, pharmaceuticals, and textiles, plus more than 75 per cent of the country's electrical equipment, machinery, and rubber goods. São Paulo ranks as the leading Brazilian producer of motor vehicles. Other important products include cement, clothing, footwear, furniture, plastics, and processed foods. Nearby rivers provide São Paulo's industries with hydroelectric power.

Highways and railroads link São Paulo to agricultural areas and to other Brazilian cities. Two international airports serve the city.

History. Jesuit missionaries from Portugal founded São Paulo as an Indian mission in 1554. As a result of attacks by hostile Indians, the Jesuits joined with some nearby Portuguese colonists and formed one community. The people of São Paulo were poor during this early period. Many of them organized groups to travel to the interior of South America in search of wealth. Members of these groups were called bandeirantes.

Until the mid-1600's, the bandeirantes sought mostly Indians, whom they captured and sold as slaves to other settlers. The bandeirantes later prospected for gold and precious gems. In 1698, bandeirantes discovered gold northeast of São Paulo. But the gold rush that followed this discovery produced little wealth.

In time, cattle trading and sugar planting brought wealth to some Paulistas. By 1800, São Paulo was an administrative and commercial center of over 20,000 persons. In 1822, Prince Regent Pedro of Portugal declared Brazil's independence while visiting the city.

Coffee planting spread to the area near São Paulo during the mid-1800's. São Paulo soon became the commercial center of Brazil's coffee industry. The state government encouraged immigration, and foreigners poured into the area. São Paulo's industrial growth began in the late 1800's, when coffee profits were invested in new industries in the city. São Paulo became the capital of São Paulo State in 1891. The city's population increased from about 25,000 in the 1870's to about 240,000 in 1900.

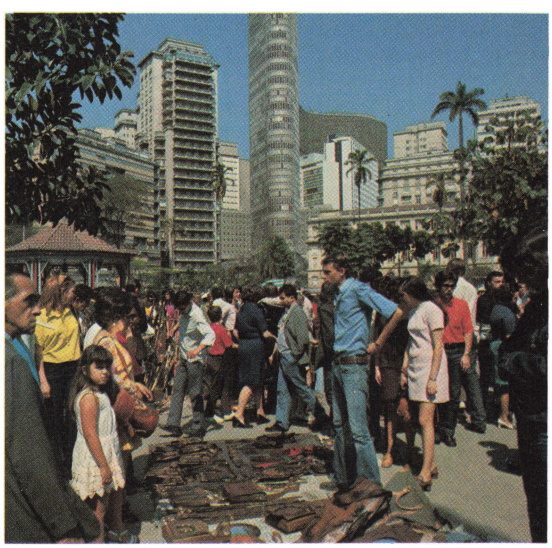
Throughout the 1900's, São Paulo has played an important part in Brazilian politics. In 1932, the city was the base of an unsuccessful revolt against President Getúlio Vargas. From 1968 to 1970, student protests and acts of guerrilla rebellion against the nation's military rule took place in São Paulo.

São Paulo's population has grown rapidly during the 1900's. In 1970, the city had more than 5 million people. The rapid growth has hampered the solution of the city's problems. During the 1970's, the city, state, and federal governments began to take action to control São Paulo's growth. As a first step, the governments encouraged industrial development in areas other than São Paulo.

RICHARD M. MORSE

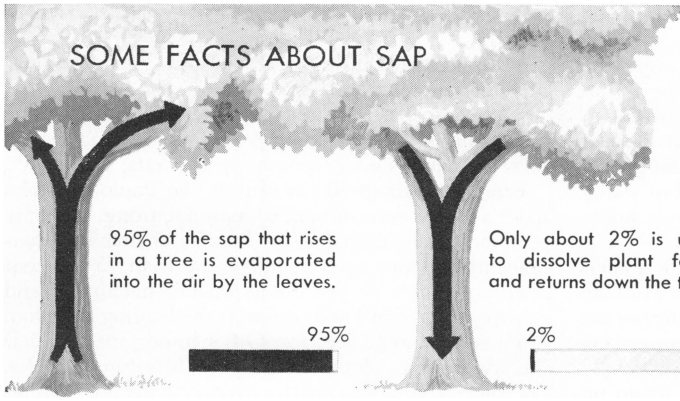
See also BRAZIL (pictures).

SÃO TIAGO. See CAPE VERDE ISLANDS.

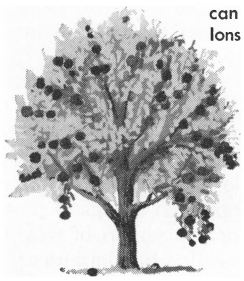


Gavin A. Mather, DPI

São Paulo's Plaza of the Republic is the site of a weekly arts and crafts market. Shoppers browse through displays of leather goods and other items that are offered for sale.



An average-sized apple tree can lift and distribute 4 gallons (15 liters) of sap an hour.



The force that raises the sap is strong enough to lift it to the top of a tree over 300 feet (91 meters) high.

A tapped maple tree will give more than 100 drops of sap each minute.

SÃO TOMÉ AND PRÍNCIPE, *sown too MEH, PREEN see pih*, is an independent country in West Africa. It lies in the Gulf of Guinea. For location, see AFRICA (political map). The country consists of São Tomé Island and Príncipe Island, and covers 372 square miles (964 square kilometers). It has a population of 84,000. The city of São Tomé is the capital of the country. See also PRÍNCIPE ISLAND.

SAÔNE RIVER, *sohn*, is a waterway in eastern France. It rises near the foothills of the Vosges Mountains and flows for 268 miles (431 kilometers). The Saône, the most important branch of the Rhône River, joins it at Lyon. Light ships can sail on it for 232 miles (373 kilometers). The industrial city, Chalon-sur-Saône, lies on its banks. Canals connect the Saône River to the Moselle, Marne, Yonne, and Loire rivers. For location, see FRANCE (physical map).

SAP, in botany, means the liquid in the stems and roots of plants. There are really two kinds of sap. One kind is water, with dissolved minerals, that travels from the roots to the leaves. It moves through a layer in the stem and trunk called the *xylem*. The other kind of sap is water carrying dissolved plant foods. It moves from the leaves to parts of the plant where it is to be used or stored. This sap moves in a layer called the *phloem*.

How Sap Moves. The xylem sap movement begins near the growing tip of the root, where water and minerals enter the plant. From the region of the root hairs, the water with the minerals dissolved in it moves toward the inside of the root by diffusion. When it reaches the xylem layer in the root, it moves up the root into the xylem of the stem. Finally it passes to the leaves. The force that causes the sap to rise is, to a great extent, a pull from above. The pull results from the *transpiration* (evaporation) of the water from the leaves.

In young trees, the water moves through the xylem in all parts of the wood. But in old trees, the only part of the xylem that transports sap is the part near the bark. This part of the wood is called *sapwood*. The part through which the sap does not move is called the *heartwood*. It is usually possible to tell these two kinds of wood from each other by their color. Sapwood is usually light in color, while heartwood is usually much darker.

The leaves are the organs of the plant which manufacture carbohydrates from carbon dioxide and water. The plant then uses the carbohydrates as food. Carbohydrates dissolve in water, and form the other kind of sap. In the stems and trunk of the plant, this stream of sap moves downward. The force which causes the downward movement of phloem sap is probably the high osmotic pressure. This pressure results from the movement of water into the sugar-rich cells of the leaves. The pressure passes to the conducting cells of the phloem, and a column of sap is forced downward. At certain times of the year, in some trees, the stream moving upward may also contain carbohydrates. An example is the sugar maple, whose rising sap contains sugar.

Uses of Sap. The sap of many plants is valuable to man. Most sugar sold in stores is made from the sap of sugar cane. The sugar maple is also a source of sugar and syrup. Plants contain other liquids that are not true saps, in the botanical sense. The milky juice of milkweed is an example. Many milky juices have great value. The milky juice of rubber trees becomes the raw material for natural rubber. Gums and resins also are valuable plant juices. ARTHUR W. GALSTON

Related Articles in WORLD BOOK include:

Gum	Phloem	Rubber (Natural Rubber)
Maple Syrup	Resin	Turpentine
Osmosis		

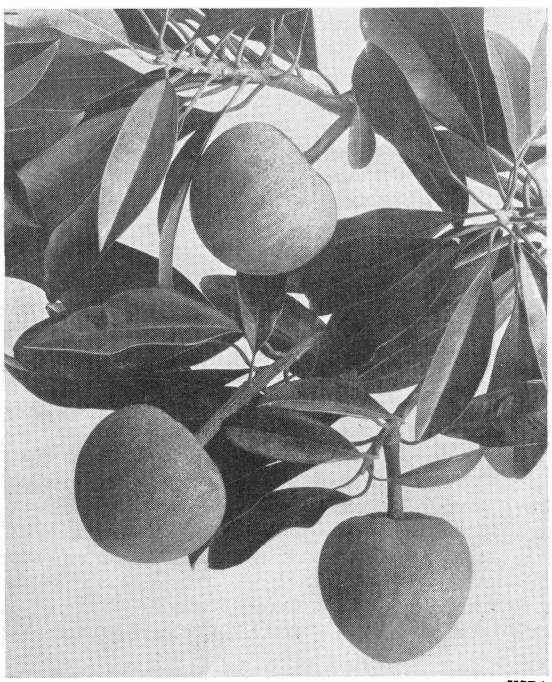
SAPAJOU. See CAPUCHIN.

SAPIR, *suh PEER,* **EDWARD** (1884-1939), was an American anthropologist. He won fame for his studies of American Indian languages and for his development of general linguistics. He taught at the University of Chicago and Yale University, and wrote *Language, an Introduction to the Study of Speech* (1921). Sapir was born in Lauenberg, Germany. DAVID B. STOUT

See also LINGUISTICS (The Structuralists).

SAPODILLA, *SAP oh DILL uh,* is an important tropical tree. It produces the chicle used to make chewing gum. It also grows a delicious fruit. The sapodilla is native to tropical America. It now also grows in southern Florida, India, Sri Lanka, and many other areas.

The sapodilla tree is an evergreen and grows 50 to 60 feet (15 to 18 meters) high. The bark contains a milky juice that is boiled down to make chicle. The fruit measures about 3 inches (7.6 centimeters) across, and



USDA

The Sapodilla Tree is a tropical plant that has leathery evergreen leaves and apple-shaped fruits. The flesh of the fruit is thick, soft, and sweet, and is delicious to eat.

may be round, oval, or cone-shaped. It has a reddish-brown skin, and black seeds. Its thick, soft, yellowish-brown pulp tastes somewhat like a pear and smells like flowers. It is an important food in tropical America. The sapodilla tree is sometimes called the *sapota.*

Scientific Classification. The sapodilla belongs to the sapodilla family, *Sapotacae.* It is classified as genus *Achras,* species *A. zapota.* JULIAN C. CRANE

See also CHICLE; CHEWING GUM.

SAPONIN. See SOAPBERRY.

SAPOTA TREE. See SAPODILLA.

SAPPHIRA. See ANANIAS.

SAPPHIRE, *SAF ire,* is a transparent gem, a variety of the mineral *corundum.* The best-known variety of sapphires has blue tints caused by impurities of iron and titanium, but sapphires exist in all the colors of the rainbow. The colored varieties are known as fancy sapphires, except the red gems, which are rubies.

The best sapphires once came from Kashmir, in northern India. Jewelers consider the typical cornflower blue color of Kashmir sapphires as the measure of fine color in a sapphire. Large stones nearly equal a fine diamond in value. The highly prized *star sapphires* have a crystal structure that reflects light in starlike rays. This effect is called *asterism.* The largest blue star sapphire in the world, called the *Star of India,* is on exhibit in the American Museum of Natural History in New York City. It weighs 563 carats (see CARAT). The gem was stolen in 1964, but was later recovered.

The best sapphires now come from Burma and Thailand. Those from Sri Lanka are often pale. Australian sapphires have a rich blue color in natural light, but appear black in artificial light. These sapphires have less value than Kashmir stones, which keep their color at night.

Large, heavy sapphires have weighed as much as 2 pounds (0.9 kilogram). The sapphire is second only to the diamond in hardness. For this reason, the stone is often used as an abrasive or polishing agent. It is also used as a needle in playing phonograph records. The sapphire is the birthstone for September. Ancient peoples regarded it as a love charm. FREDERICK H. POUGH

See also CORUNDUM; GEM (color picture); RUBY.

SAPPHO, *SAF oh,* a Greek woman poet, lived about 600 B.C. Plato called her the *Tenth Muse,* and she is supposed to be the greatest woman poet the world has known. Little of her poetry has survived. We have only two short lyrics and odd lines quoted by ancient critics and grammarians. These show intense but controlled emotion expressed in language which seems wholly natural. Later poets, especially the Romans Catullus and Horace, imitated her special meter, the Sapphic.

Sappho lived at Mitylene (now Mitilíni) on the island of Lesbos. There, she led a circle of young women who were her disciples. She was married, and had a daughter named Cleis. MOSES HADAS

SAPPORO, *sahp POH roh* (pop. 1,010,123), is the capital of Hokkaido, Japan's northernmost island. It lies on the western part of the island near Otaru Bay (see JAPAN [political map]).

Sapporo was laid out in 1871, and was patterned after western cities. It is important because it serves as the island's manufacturing and cultural center. Products of the island include hemp cloth and rubber goods, as well as such food products as condensed milk and processed soybeans. Sapporo's chief attractions include Hokkaido University and the botanical gardens, which specialize in alpine flora. Residents and visitors enjoy the ski slopes, located in the suburbs, and Jozānkei hot springs, 11 miles (18 kilometers) southwest.

SAPROPHYTE, *SAP roh fite,* is a living thing that must get its food from dead plants or animals. The saprophytes are chiefly plants that lack the green substance chlorophyll. Plants with chlorophyll can manufacture their food from water and the carbon dioxide of the air, by the process of photosynthesis (see PHOTOSYNTHESIS). Saprophytes must depend on food that has

already been made by some other living thing. The best-known saprophytes are the plants known as fungi. They include mushrooms, molds, mildew, and bacteria. Partial saprophytes may live part of their lives on dead plants and animals, and part on living plants and animals. Some bacteria are partial saprophytes. Animals or plants that live on living organisms are called *parasites*. See also CHLOROPHYLL; FUNGI. WILLIAM C. BEAVER

SAPSUCKER is one of a group of birds of the woodpecker family. It lives only in North America. Sapsuckers are so called because part of their diet includes sap from trees. They get this sap by making holes in the bark. They also feed on ants and wild fruit. The common sapsucker in the East is the *yellow-bellied sapsucker*. The male has a bright scarlet crown and throat, and black upper parts with white markings. This sapsucker nests in the northern United States and Canada. In the winter, it flies as far south as Central America. It builds its nest in holes in trees. The female lays 3 to 7 eggs which are pure white. The western *red-breasted sapsucker*

John H. Gerard

The Yellow-Bellied Sapsucker drills so many holes in the bark of tree trunks that its work often kills small trees.

lives on the Pacific Coast. The adults of both sexes have the crown, throat, and breast entirely red. The *Williamson's sapsucker* is found in mountain regions of the western United States.

Sapsuckers have much the same habits as woodpeckers, but sometimes injure trees. When large numbers of sapsuckers are found in any locality, it may be necessary to drive them away. The Williamson's sapsucker, however, does little damage to trees.

Scientific Classification. Sapsuckers are members of the woodpecker family, *Picidae*. The yellow-bellied sapsucker is genus *Sphyrapicus*, species *S. varius*. Williamson's sapsucker is *S. thyroideus*. HERBERT FRIEDMANN

SAPWOOD. See SAP; TREE (How Trunks and Branches Grow Thicker; picture: How a Tree Reveals Its History).

SARABAND. See DANCING (The Renaissance).

SARACEN, *SAR uh sun*, was the name used first in the Middle Ages for the Moslems who invaded and occupied large parts of the Christian world in Asia, Africa, and Europe. This occupation took place during the 600's and 700's. The Saracens included the people of Palestine and Syria, Arab Moors who set up the Spanish kingdom in the 700's, and Seljuk Turks who fought the Crusaders. The Greeks and Romans first used the term *Saracen* to describe the wandering Arab tribes of the Syro-Arabian Desert. WILLIAM C. BARK

SARAGAT, *sah rah GAHT*, **GIUSEPPE** (1898-), served as president of Italy from 1964 to 1971. Parliament elected Saragat, a Socialist, after a bitter debate between liberal and conservative members.

Saragat joined the Socialist Party in 1922, and was a member of its executive committee by 1925. He represented the party in the cabinet formed in 1944. In 1946, he was named president of the Constituent Assembly that wrote a new constitution. Saragat broke with the Socialist Party in 1947 after it became connected with the Communist Party. He formed his own party, which later became the Democratic Socialist Party. He served as deputy premier from 1946 to 1948 and from 1954 to 1957. Saragat was born and educated in Turin.

SARAGOSSA, *SAR uh GAHS uh*, or ZARAGOZA, *SAH rah GOH thah* (pop. 479,845), is an industrial and trading center in northeastern Spain. The city has metalworks, sugar refineries, chemical plants, and factories that manufacture electrical equipment, agricultural machinery, and furniture. For the location of Saragossa, see SPAIN (map).

The central part of Saragossa is a district of ancient, crowded lanes and dilapidated houses. An attractive newer section has grown up around the old quarter.

The city's name comes from *Caesarea Augusta*, which was the name Emperor Augustus gave to the settlement in 25 B.C., when he made it a Roman colony. Saragossa was the capital of the old kingdom of Aragon from the 1100's to the 1400's. STANLEY G. PAYNE

SARAH. See ISHMAEL; ISAAC.

SARAH LAWRENCE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SARAJEVO, *sah RAH yeh vaw* (pop. 227,000), is a trading center in Yugoslavia. For location, see YUGOSLAVIA (color map). On June 28, 1914, the Austrian Archduke Francis Ferdinand and his wife were assassinated in Sarajevo. This was the immediate event that started World War I. See also WORLD WAR I (introduction). HIBBERD V. B. KLINE, JR.

SARAN is a synthetic plastic material manufactured as a thin flexible film or sheet, or as a textile fiber. It is also known as VELON and CRYOVAC. Its chemical name is *vinylidene chloride polymer*. Saran film is strong, transparent, and moistureproof. It is often used as a wrapping for meat, fruit, and vegetables. Saran fibers and yarns make excellent belts, insect screens, and automobile seat covers. Commercial methods for making Saran were developed by the Dow Chemical Company in the 1940's. ERNEST R. KASWELL

SARANAC LAKES are the Upper Saranac, Middle Saranac, and Lower Saranac. The lakes lie in the Adi-

rondack Mountains of northeastern New York. The Upper Saranac is the largest. It is about 8 miles (13 kilometers) long, and nearly 2 miles (3.2 kilometers) wide in places. The lake contains brook, lake, and rainbow trout; and whitefish. The Middle Saranac, usually known simply as Lake Saranac, is nearly 3 miles (4.8 kilometers) long and over 1 mile (1.6 kilometers) wide. The Lower Saranac is over 5 miles (8 kilometers) long and over 1 mile (1.6 kilometers) wide. These lakes lie near each other, and total nearly 14 square miles (36 square kilometers) in area. The action of huge glaciers created them thousands of years ago. The region attracts tourists and sportsmen. See also NEW YORK (Places to Visit). WILLIAM E. YOUNG

SARASOTA, Fla. (pop. 40,237; met. area 120,413), lies on Sarasota Bay in southwestern Florida (see FLORIDA [political map]). Chief industries are agriculture, livestock raising, and tourism. The Ringling Brothers and Barnum & Bailey circus had winter quarters there from 1927 to 1960. Sarasota still has the John and Mable Ringling Art Museum, and the Circus Hall of Fame. It is also the home of New College, a campus of the University of South Florida. Scottish families founded Sarasota in the 1880's. It has a council-manager government. KATHRYN ABBEY HANNA

SARATOGA. See AIRCRAFT CARRIER.

SARATOGA, BATTLE OF. See REVOLUTIONARY WAR IN AMERICA (Defeat at Saratoga).

SARATOGA NATIONAL HISTORICAL PARK. See NATIONAL PARK SYSTEM (table).

SARATOGA SPRINGS, N.Y. (pop. 18,845), is a health resort and horse-racing center. It lies in the southeastern foothills of the Adirondack Mountains. For location, see NEW YORK (political map).

In 1910, the state took over the city's mineral springs. The National Museum of Racing in Saratoga Springs has trophies and other horse-racing exhibits. Skidmore College is in the city. Saratoga National Historical Park is nearby. The city built a $4,100,000 cultural center that is a summer home for the Philadelphia Orchestra and the New York City ballet. Saratoga Springs has a commission government. WILLIAM E. YOUNG

SARATOV, *suh RAH tuf* (pop. 773,000), is one of the chief ports on the Volga River. For location, see RUSSIA (political map). It stands about 450 miles (724 kilometers) southeast of Moscow.

SARAWAK, *suh RAH wahk*, is a state in the Federation of Malaysia. The state lies on the northwestern coast of the island of Borneo. Sarawak has an area of 48,050 square miles (124,450 square kilometers), and a population of 1,150,000. For location, see MALAYSIA (map). Sarawak has a tropical climate. Its products include sago palm, timber, rubber, pepper, coconuts, and camphor. Kuching is the capital. Most of the people of Sarawak are Dyaks, Malays, Melanaus, and Muruts. Many Chinese and a few Europeans also live there.

James Brooke, an Englishman, and his heirs ruled Sarawak as the *white rajahs* for a hundred years. Brooke helped the Sultan of Brunei put down a rebellion in 1839 and 1840. The sultan gave Sarawak, which was part of his land, to Brooke. The Japanese took Sarawak in World War II. In 1946, the ruling rajah ceded Sarawak to England. Sarawak became part of the Federation of Malaysia in 1963. NORTON GINSBURG

See also BORNEO; DYAK; KUCHING; MALAYSIA.

SARAZEN, GENE (1902-), an American golfer, became one of the world's leading players. In 1922, at the age of 20, Sarazen won both the United States Open and the Professional Golfers' Association (PGA) tournaments. He won the PGA tourney again in 1923 and 1933. In 1932, Sarazen won both the U.S. Open and the British Open.

In 1935, Sarazen won the Masters tournament. In the last round, he sank one of the most remarkable shots in golf history—a 235-yard (215-meter) shot that gave him a double eagle on the 15th hole. He tied for first place with Craig Wood, whom he defeated in a play-off the next day. Sarazen played on six American teams in the Ryder Cup competition between American and British professional golfers.

Sarazen was born in Harrison, N.Y., near Rye. His real name is Eugene Saraceni. HERMAN WEISKOPF

SARCASM. See HUMOR (The Types of Humor).

SARCODINA. See PROTOZOAN (Kinds).

SARCOIDOSIS, *sahr koy DOH sihs*, is a disease in which small tumorlike lumps form in many parts of the body. Scientists do not know the cause of the disease.

Sarcoidosis can occur in one or more organs, including the bones, eyes, liver, skin, and spleen. In most cases, it occurs in the lymph nodes of the chest and lungs. Lymph nodes are special tissues that help the body fight infection (see LYMPHATIC SYSTEM). The disease seldom causes death, but it can lead to severe lung damage or other serious complications. Scientists believe sarcoidosis is not contagious.

Symptoms of sarcoidosis may resemble those of cancer or tuberculosis. Sarcoidosis in the lungs may cause coughing, accompanied by fatigue or fever. But some victims of the disease never develop its symptoms.

Sarcoidosis can be diagnosed through chest X rays, examination of tissue from one of the lumps, and a skin test called the *Kveim test*. A blood test also can be used to confirm a diagnosis of the disease.

Most sarcoidosis victims are from 20 to 40 years old. Ireland, Norway, and Sweden have reported the most cases in proportion to population. In the United States, the disease occurs among a higher proportion of Negroes and Puerto Ricans than of other groups.

Some sarcoidosis patients have been effectively treated with the drug *cortisone*. Many victims of the disease recover without treatment in a period ranging from a month to two years. JACK LIEBERMAN

SARCOLACTIC ACID. See LACTIC ACID.

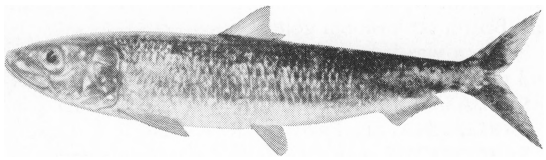
SARCOPHAGUS, *sahr KAHF uh guhs*, is a stone coffin. The ancient Egyptians probably first made a sarcophagus for the burial of a king. Some Egyptian sarcophagi were shaped like small houses, others as ovals or oblongs. Many were covered inside and out with inscriptions and figures of gods intended to protect the body from decay. The Etruscans made sarcophagi of terra cotta. The Romans used marble or stone. The Greeks often decorated their coffins with carved bas-reliefs.

The best-known modern sarcophagi include those of George Washington in Mount Vernon, Napoleon Bonaparte in Paris, the Duke of Wellington in London, and the tomb of V. I. Lenin in Moscow. KEITH C. SEELE

See also NAPOLEON I (picture); TOMB; SCULPTURE (picture: The Alexander Sarcophagus).

United Press Int.

Sardine Fishermen scoop up their catch, *above*. The California sardine, or Pacific pilchard, *below*, weighs about 4 ounces (110 grams) and grows about 10 inches (25 centimeters) long.



SARDINE, *sahr DEEN*, is a small fish of the herring family (see HERRING). It is also known as the *pilchard*. Sardines are found in great numbers along the coasts of Europe and North America. The name *sardine* comes from the fact that this fish was first caught off the island of Sardinia, near Italy. Today, sardines can be found in the Bay of Biscay near France and along the coasts of the English Channel and the Mediterranean Sea. Fishermen catch sardines off the coasts of California, Oregon, Washington, Baja California, British Columbia, and Japan. The California, or Pacific Coast, sardine is about 10 inches (25 centimeters) long and weighs about 4 ounces (110 grams). The upper parts of its body appear dark blue and the lower parts silvery.

Sardines eat the tiny one-celled plants and animals that live in the ocean. They usually swim in large groups called *schools*. In the daytime, sardines can be seen in the water as tiny black spots, causing ripples. At night, they may glow in the dark water.

Sardines are important as food and for the oil they contain. Fishermen catch them in large nets. Some of the sardine catch goes to canneries. Industry uses sardine oil in varnish, paint, margarine, and many toilet preparations. Some sardines are dried, pounded into powder, and placed in sacks. Called *fish meal*, this is used for chicken feed and fertilizer. In southern France, sardines preserved in red wine are a delicacy.

The sardine industry ranks as one of the biggest fishing industries in British Columbia. Young herring, menhaden, or other small fishes are sometimes sold on the market as sardines.

Scientific Classification. Sardines belong to the herring family, *Clupeidae*. The European sardine is genus *Sardina*, species *S. pilchardus*. The Pacific sardine is *Sardinella sagax*.

LEONARD P. SCHULTZ

SARDINIA, *sahr DIHN ih uh*, or in Italian, SARDEGNA, is an Italian island in the Mediterranean west of the mainland of Italy and over 100 miles (160 kilometers) from it. The nearest land is the French island of Corsica, 9 miles (14 kilometers) north across the Strait of Bonifacio. Sardinia is second largest of the Mediterranean islands. Only Sicily is larger. Sardinia is about 166 miles (267 kilometers) long from north to south. It has an area of 9,301 square miles (24,089 square kilometers). This island and some small ones nearby form the region of Sardinia, which has a population of 1,448,011. For location, see ITALY (physical map).

Mountainous Area. Nine-tenths of Sardinia is mountainous. The only important area of lowlands is the southwestern plain. Human settlement in the mountains is difficult because the steep slopes and heavy rainfall produce landslides and floods. The agricultural improvement of the small areas of level land has been retarded in places by malarial swamps and elsewhere by lack of moisture during the hot, dry summers. These problems are gradually being overcome by drainage projects and by irrigation. In 1957, experts predicted that these projects would increase the land value five or six times and provide employment for many workers. The most important agricultural products include almonds, grapes, herbs, lemons, olives, oranges, and wheat. Many goats and sheep are raised. Tunny and lobster are brought in to local fisheries. Sardinia is also one of Italy's leading cork producers. Ancient mines in the mountains still produce copper, iron, lead, lignite, manganese, silver, zinc, and other minerals.

Sardinia is divided into the provinces of Sassari, Nuoro, and Cagliari. The chief cities bear these same names. The city of Cagliari is also the capital of the region. Even these settlements have little industry. Most of the products, including fish, goatskins, mineral ores, olives, and wine, are exported with a minimum of processing or manufacturing.

History. Sardinia has been invaded and ruled by first one power and then another. These have included Carthage, Rome, the Vandals, Byzantium, the Moslems, the city-states of Pisa and Genoa, Aragon, Piedmont, and finally unified Italy. Sardinia preserves many ancient customs, traditions, and costumes.

During World War II, Sardinia became an important airplane and naval base for Fascist Italy. In 1943 American fighter planes smashed two convoys at Sardinia, and destroyed many airfields. American Flying Fortress attacks later damaged more Italian vessels lying in Sardinia's naval base. But the war made little permanent impression on Sardinia.

BENJAMIN WEBB WHEELER

See also CAGLIARI; SARDINIA, KINGDOM OF.

SARDINIA, KINGDOM OF, became the nucleus of united Italy. The kingdom was founded in 1720 when the Duchy of Savoy was united with the island of Sardinia, with the Alpine fortresses of Aosta, Fenestrelle, Pinerolo, and Saluzzo, and with Montferrato, a *marquisate*, or area governed by a marquis. Duke Victor Amadeus II of Savoy was made the first monarch of the kingdom of Sardinia.

Pinned between French, Austrian, and Spanish powers, Sardinia inherited the geographic liabilities of old Savoy. The kingdom allied itself with Austria in the 1700's. Napoleon annexed Sardinia to France in 1802. After his defeat in 1815, it was restored, and Genoa and Liguria were added to it. It became the foremost independent state in Italy, but Austria dominated affairs in most of the peninsula.

When Charles Albert became king of Sardinia in 1831, it became the hope of Italy. He granted his people a new constitution in 1848. During the revolution against Austria in that year, Charles tried to

drive the enemy from Lombardy and Venetia. Indecision cost him the victory and his throne. His son, Victor Emmanuel II, succeeded him. Through the efforts of his great prime minister, Camillo Benso, Count di Cavour, the movement for unifying Italy succeeded.

Cavour obtained an alliance with France and provoked war with Austria in 1859. After the bloody battles of Magenta and Solferino, Cavour resigned his office when France made a separate peace with Austria at Villafranca before Italy had been liberated. But all was not lost. Popular assemblies in Modena, Parma, and the Romagna voted union with Sardinia in 1860. Giuseppe Garibaldi and his glorious "thousand" volunteers brought southern Italy into the nation. In 1861, Victor Emmanuel II was proclaimed king of a united Italy that included Sardinia. WILLIAM H. MAEHL

See also CAVOUR, COUNT DI; ITALY (History; map: Italy—Late 1800's); SARDINIA; VICTOR EMMANUEL (II).

SARDIS, an ancient city near present-day Izmir, Turkey, was capital of the kingdom of Lydia. The oldest remains of Sardis go back to the 1300's B.C., but there are other indications that the city is older. Persians conquered Sardis in 546 B.C. The city was later destroyed and rebuilt several times, until its final destruction by the Sassanian Persians about A.D. 615. JACOB J. FINKELSTEIN

SARDIS DAM is one of the largest earth-filled flood-control dams in the United States. About 16,450,000 cubic yards (12,577,000 cubic meters) of material went into its construction. Sardis, one of the largest dams in the U.S., stands on the Little Tallahatchie River, in northwestern Mississippi. Sardis Dam chiefly serves flood-control purposes. The dam is 118 feet (36 meters) high, almost $\frac{1}{4}$ mile (0.4 kilometer) wide at its base, and 15,300 feet (4,663 meters) long along the top.

Sardis Reservoir, behind the dam, is over 30 miles (48 kilometers) long. The United States Army Corps of Engineers completed the dam in 1940. T. W. MERMEL

See also DAM.

SARDONYX, *SAHR doh nicks*, is a form of quartz used in rings and other jewelry. It is a variety of agate and is cut from flat layers of banded masses of agate. It is found in Arabia, Brazil, India, Ireland, Israel, Scotland, and Uruguay. Sardonyx is one of the cheaper gem stones. Jewelers cut it flat, convex, or dome-shaped to bring out its full color of brown, golden, or blood red. Sardonyx is one of the birthstones for August. Saint John called it the fifth of the foundation stones in his description of the Holy City (Rev. 21:20). Many ancient myths and legends were built around the sardonyx. See also CAMEO; GEM (color picture); ONYX. FREDERICK H. POUGH

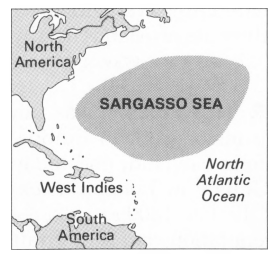
SARDOU, *SAHR DOO*, **VICTORIEN** (1831-1908), was one of the most successful French playwrights of his time. His light comedies, such as *Diplomacy* and *A Scrap of Paper*, were popular for years. He was a master of the *well-made play*, which emphasized plot construction.

Sardou was born in Paris. His dramas earned him a large fortune, and election to the French Academy in 1878. His *La Tosca* became the basis of Giacomo Puccini's opera of the same name. JOHN W. GASSNER

SARGASSO SEA is an irregular oval-shaped area of the North Atlantic Ocean. Its center is about 2,000 miles (3,200 kilometers) west of the Canary Islands. It lies roughly between the 20th and 40th parallels of north latitude, and between the 35th and 75th meridians west of Greenwich. No land boundaries of any kind mark off this body of water from the rest of the open ocean. It is set apart only by the presence of marine plants, or seaweed, which float on its surface. It is also a region of slow ocean currents surrounded by a boundary of rapidly moving currents, such as the Gulf Stream and the North Equatorial Current. The Sargasso Sea derives its name from *sargaço*, one of the Portuguese words for seaweed. The word originally meant grape, because the small floats on some seaweeds resemble grapes. Christopher Columbus is given credit for the first reliable report on this region. He sounded the Sargasso Sea in 1492 to make sure that no rocks lay beneath the weeds.

The Legends of the Sea

The early navigators who sailed their small ships to North America saw the Sargasso Sea as patches of gulfweed that seemed to form wide-spreading meadows. Soon there were legends and myths about the region which told of large islands of thickly matted seaweed inhabited by huge monsters of the deep. Poets and novelists used their imaginations in describing the sea. They pictured a blanket of netted seaweed from which no ship could escape, once it became entangled in the weed. They described many of the ghost ships of the past as huddled together in a weaving, rotting mass. Shapeless hulks of ancient galleons, covered with weeds and barnacles, were pictured lying beneath the waters of this mysterious sea. The passing years contributed skeletons of slave ships, then of pirate ships, and later of the gallant ships of Revolutionary War days. Wrecks of smart clipper ships and the latest doomed ships completed the legendary collection.



WORLD BOOK map
Location of the Sargasso Sea

The Facts About the Sea

Scientists have changed the picture of the Sargasso Sea. They have shown that its area is about 2 million square miles (5.2 million square kilometers), and they have opened up fascinating research problems.

Origin of the Seaweed. Scientists believe that the seaweed first came from the shores of the West Indies, after it had been torn loose by wind and wave. Parts of it became adapted to living and growing in the open sea. The weeds developed a method of reproduction which enables them to multiply and grow without producing seeds. Waves break off sections of the mature plants. These fragments then grow into full-size plants in the same way that a cutting from a grape plant grows into a large grapevine. The weeds are supported by air sacks which resemble tiny grapes, and grow as a part of the weeds. Sargassum weeds grow in many ocean regions. One variety is used as food in Japan.

Many small marine animals have adapted themselves to growing on and among the weeds. These animals include tiny crabs, shrimps, and barnacles. Fish

can see at depths as great as 1,200 feet (366 meters) in the Sargasso Sea, the deepest that fish can see in any ocean. Sargassum fish are difficult to distinguish from Sargassum weeds, because the fish have taken on the colors and patterns of the weeds.

The greatest quantity of seaweed is found in the central part of the Sargasso Sea. It occurs in scattered masses, some 100 feet (30 meters) in diameter. Wind action forms long strips of the weed, which follow the general direction of the wind. Patches of the weed may cover more than 1 acre (0.4 hectare). Nowhere is the region so thickly covered that the weeds can interfere with the movements of a ship. Sometimes, unusually strong winds or currents cause some of the weeds to drift into the Gulf Stream, and eventually to New England or even Ireland and Norway.

Waters of the Sea. The waters of the Sargasso Sea have many distinctive features. The water has an unusually deep blue color; a high salt content (3.7 per cent); a high temperature (up to 83° F., or 28° C); and extreme clearness. These features result chiefly from the location of the sea and its great depth, averaging over 3 miles (4.8 kilometers). Also, there are no islands nearby except for Bermuda. WAYNE V. BURT

See also SEAWEED.

SARGENT, JOHN SINGER (1856-1925), was an American painter who did his major work in Europe. He lived much of his adult life in England, and today his works hang in the Tate Gallery in London as examples of English painting of the late 1800's.

Sargent established his reputation as a portrait painter, and is best known for his perceptive portraits of fashionable people. Although he might broadly brush in his subjects' clothing or accessories, he captured with remarkable penetration their personalities. Sargent paintings appear in the HERCULES; HOSEA; and PROPHET articles.

Sargent was born in Florence, Italy, to American parents. He made the first of many trips to the United States in 1876. He studied in Italy and France and his first major exhibition was at the Paris Salon of 1878. Sargent moved to London in 1884 and made England his permanent home although he never became a British subject. During the last dozen years of his life, he virtually gave up portrait painting to paint other more personally satisfying subjects and murals. The Brooklyn Museum displays many of Sargent's water colors. His murals may be seen at the Boston Public Library.

Sargent received many awards and honors during his lifetime, but his reputation declined after his death. However, since the mid-1950's interest has slowly revived in his work. GEORGE EHRLICH

SARGENT, SIR MALCOLM (1895-1967), a British conductor, was appointed conductor in chief of the British Broadcasting Corporation (BBC) orchestra in 1950. This is one of the most important musical posts in Great Britain. Previously he was principal conductor of the Liverpool Philharmonic. Sargent conducted premières of important works by Ralph Vaughan Williams and Sir William Walton. He was born in Lincolnshire. IRVING KOLODIN

SARGENT, WINTHROP. See MISSISSIPPI (Territorial Days).

SARGON, *SAHR gawn*, is the Biblical form (Isaiah 20) of a name which was applied to three rulers of ancient Mesopotamia (now approximately Iraq). The name meant *declared king*, and it was chosen by the first and third kings precisely because those kings were usurpers, yet tried to deny it. The second king took his name from the first one.

Sargon of Akkad was one of the greatest rulers in all antiquity. His exact birth and death dates are still uncertain, but they must have been not less than 4,300 years ago. We know that he ruled for 61 years.

Starting out from the obscure city of Akkad (or Agade) in what is now Iraq, Sargon first conquered all Sumer. He then extended his empire to Persia in the east and to the Mediterranean Sea and Asia Minor in the west. His was the first great empire in history.

Sargon became the first ruler to raise to prominence the Semitic inhabitants of the country. Sargon himself was a Semite. He displaced the older Sumerians, who were of an entirely different racial background. It was because of his great achievements that the whole region came to be known as Akkad, and its Semitic speech as Akkadian, after the small city in which he rose to power. See BABYLONIA (The Semites).

Sargon's many achievements gave rise to various legends. These have been preserved not only in Sargon's Akkadian, but in the languages of the Hurrians, the Elamites, and the Hittites. One legend describes the infant Sargon as being rescued from a basket that had been left in a river, as Moses was some 1,000 years later. See WORLD, HISTORY OF (picture). JOHN WILLIAM SNYDER

Sargon I of Assyria ruled about 500 years after Sargon of Akkad. His kingdom maintained profitable business colonies in Cappadocia, an area which contained mostly traders and merchants. Little is known about this ruler.

Sargon II was one of the last and greatest kings of Assyria. He ruled from 722 to 705 B.C. His many conquests included Babylonia, Armenia, Philistia, and ancient Israel, which was wiped out by its defeat. Sargon built a new capital. The town of Khorsabad now stands on its site in northeast Iraq. Sargon II died in battle in Persia (now Iran). JACOB J. FINKELSTEIN

See also SENNACHERIB.

SARI. See INDIA (Clothing).

SARK, *sahrk*, is one of the Channel Islands, about 70 miles (110 kilometers) south of England and 22 miles (35 kilometers) off the French coast. Sark is over 3 miles (4.8 kilometers) long and over $1\frac{1}{2}$ miles (2.4 kilometers) wide. It has a population of 590 and an area of 2 square miles (5 square kilometers).

Sark is the smallest self-governing unit in the United Kingdom. Many bays and coves cut into the coastline. Cliffs rise on all sides of the island. German troops occupied Sark during World War II. See also CHANNEL ISLANDS. FREDERICK G. MARCHAM

SARMIENTO, DOMINGO FAUSTINO. See LATIN-AMERICAN LITERATURE; ARGENTINA (Literature).

SARNIA (pop. 57,644), a city in southwestern Ontario, lies opposite Port Huron, Mich. Bridge and tunnel connections link Sarnia with Port Huron. Sarnia lies on the Saint Clair River, at the southern end of Lake Huron. The city is the center of Canada's petrochemical industry. Sarnia has the country's largest oil refinery and synthetic rubber factory. Englishmen

first settled the Sarnia area in the 1830's. The city has a council-manager form of government. See ONTARIO (map). D. M. L. FARR

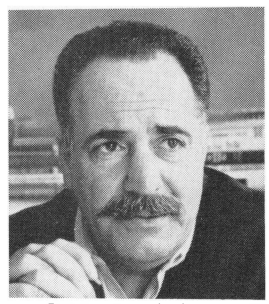
SARNOFF, *SAHR nawf*, **DAVID** (1891-1971), was one of the first businessmen to see the full possibilities of using radio and television for entertainment. He served as president of the Radio Corporation of America (now RCA Corporation) from 1930 through 1948. He was chairman of the board from 1947 to 1970. Sarnoff was born in Minsk, Russia, and came to the United States in 1900. As a messenger boy in 1906 for the Commercial Cable Company, he learned the Morse code. He later became a wireless operator for the Marconi Wireless Telegraph Company. In 1912, he picked up word that the *Titanic* was sinking, and stayed at his station 72 hours, helping to direct ships to the sinking liner.

Sarnoff operated various stations for the company, and studied electrical engineering. By 1917, he was commercial manager of the Marconi Company, which RCA took over two years later. BARNARD HEWITT

SARONG. See BATIK (picture); INDONESIA (Clothing).

SAROS. See ECLIPSE (Solar Eclipses).

SAROYAN, WILLIAM (1908-), is an American writer. He is best known for plays and stories that praise the common man's ability to live a full, happy life in a world of ugly reality. In the preface to one of his plays, Saroyan wrote: "In the time of your life, live, so that in that good time there shall be no ugliness or death for yourself or for any life your life touches." Saroyan's works show his belief in man's basic innocence. Most of them are about poor, down-and-out people whom he praises for their vitality and purity. Some of his works tend to be sentimental rather than objective, particularly his portraits of children and of working-class life.



Jerry Bauer, Pix from Publix

William Saroyan

Saroyan was born in Fresno, Calif. His first book was a collection of stories, *The Daring Young Man on the Flying Trapeze* (1934). Saroyan won the Pulitzer prize for *The Time of Your Life* (1939), the best of his several plays, but refused to accept it. He said he disapproves of literary prizes. Saroyan's other works include a novel, *The Human Comedy* (1943), and his autobiography, *Not Dying* (1963). JOSEPH N. RIDDEL

SARTO, ANDREA DEL. See DEL SARTO, ANDREA.

SARTO, GIUSEPPE. See PIUS (Saint Pius X).

SARTOR RESARTUS. See CARLYLE, THOMAS.

SARTRE, *SAHR truh*, **JEAN-PAUL** (1905-), is a French existentialist philosopher who has expressed his ideas in novels, plays, and short stories, as well as in theoretical works.

The bare existence of things, especially his own existence, fascinates and horrifies Sartre, because there seems to be no reason why anything should exist. In his first novel, *Nausea* (1938), he describes the horror and mystery which a man experiences when he considers the unexplainable fact of a thing's existence.

In his chief philosophical work, *Being and Nothingness* (1943), Sartre investigates the nature and forms of *existence* or *being*. He claims that human existence, which he calls "being-for-itself," is radically different from the existence of such inanimate objects as tables, which he calls "being-in-itself." Sartre says that only human existence is conscious of itself and of other things. He argues that inanimate objects simply are what they are; however, a man is whatever he chooses to be. Sartre says that a man is not a coward, for example, in the same simple way that a table is only a table. A man is a coward only if he chooses to be one. Sartre says that a man, unlike a table, has no fixed character or "essence" assigned to him. Primarily, man "exists" as the being who must *choose* his own character or "essence." Thus, in his essay *Existentialism and Humanism* (1946), he defines existentialism as the doctrine that, for man, "existence precedes essence." See EXISTENTIALISM.

Wide World

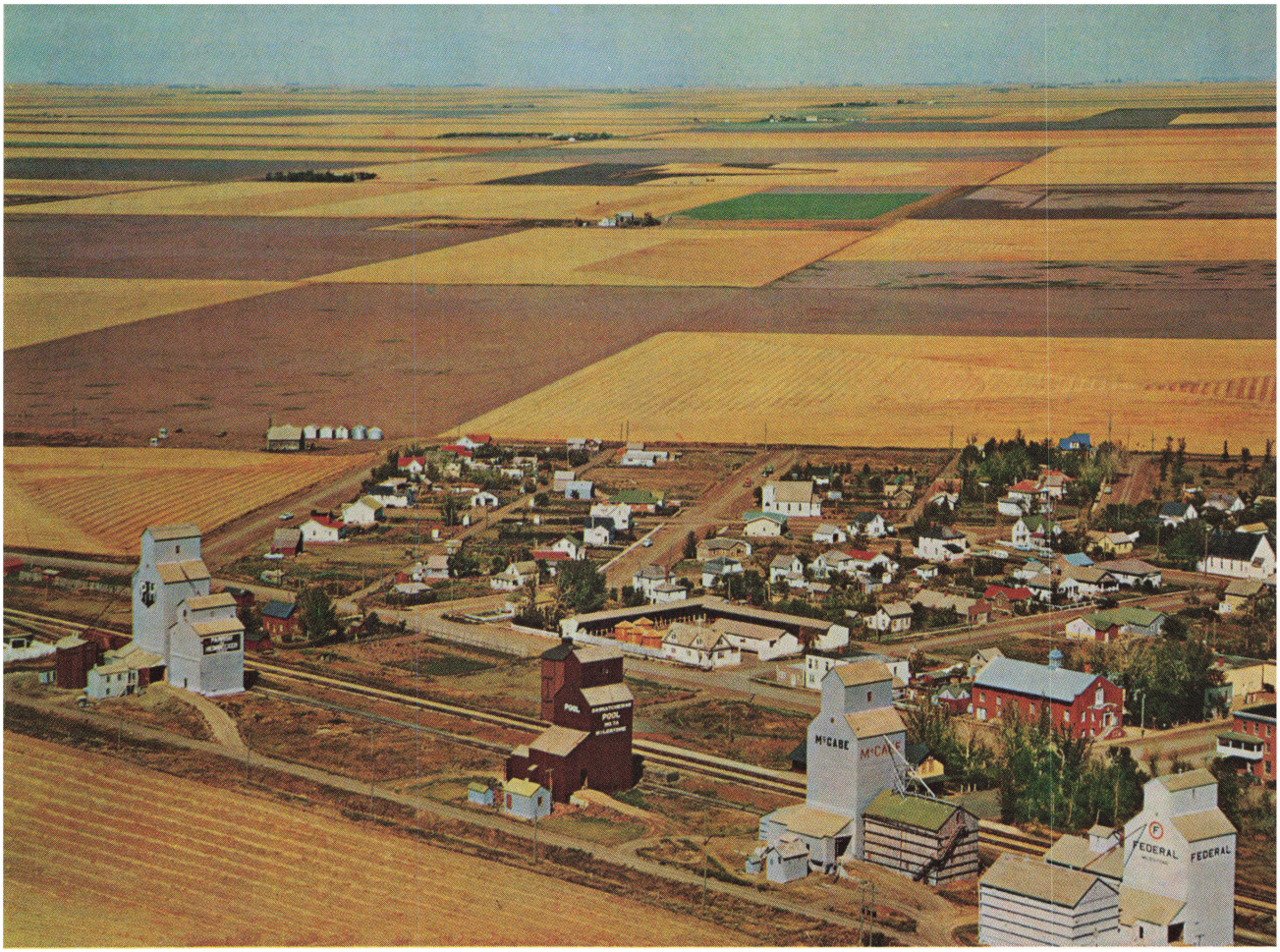
Jean-Paul Sartre

Sartre believes that man is completely free, but is afraid to recognize this freedom and to accept full responsibility for his behavior, which such freedom implies. Thus, man tends to deceive himself about his true situation. Throughout his philosophical and literary works, Sartre examines and analyzes the varied and subtle forms of *self-deception*.

Sartre criticizes Sigmund Freud's psychoanalytic theory of human behavior and offers his own "existential psychoanalysis." Sartre says that the ultimate motive for all human behavior is the desire to achieve perfect self-sufficiency by becoming the cause of one's own existence. However, he argues that this goal is actually self-contradictory and impossible to attain. Therefore, he considers all human activity ultimately futile. As Sartre says: "Man is a useless passion." He identifies this idea of a perfectly self-sufficient being who is the cause of his own existence as the traditional idea of God. According to Sartre, man ultimately wants to become God, and God cannot possibly exist. In the *Critique of Dialectical Reason* (1964), Sartre presents his political and sociological theories which he considers to be a form of Marxism.

Sartre's plays include *The Flies* (1943), *No Exit* (1945), *Dirty Hands* (1948), and *The Condemned of Altona* (1959). He wrote *The Roads of Freedom*, a sequence of novels including *The Age of Reason* (1945), *The Reprieve* (1945), and *Troubled Sleep* (1949). He applied his psychoanalytic theories in his biographies, *Baudelaire* (1947) and *Saint Genet* (1953). *Words* (1963) is the first installment of his autobiography.

Sartre was born in Paris where he studied at the École Normale Supérieure. During World War II, he fought in the French Army and was active in the French resistance. He has been editor of the monthly review *Les Temps Modernes* since he founded it in 1945. In 1964, Sartre was awarded the Nobel prize for literature, which he refused to accept. IVAN SOLL



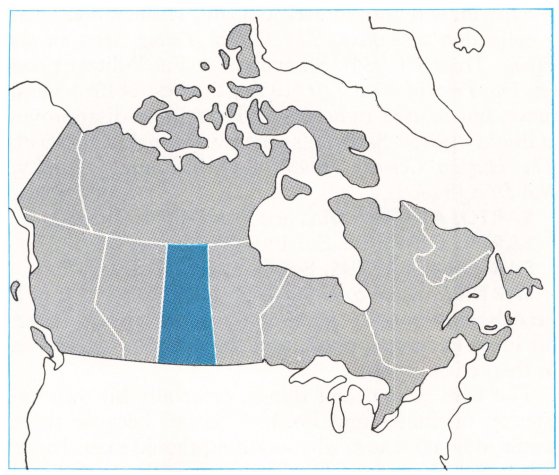
George Hunter, Publix

Vast Wheat Fields Form a Checkered Pattern on the Prairie near Milestone.

SASKATCHEWAN

SASKATCHEWAN, *sass CATCH uh wahn,* one of the Prairie Provinces of Canada, is the greatest wheat-growing region in North America. Saskatchewan farmers produce about two-thirds of Canada's wheat. The province's vast fields of golden wheat gave it the nickname of *Canada's Breadbasket.* Railroads carry huge loads of the grain to Canadian ports for shipment to all parts of the world. The Saskatchewan Wheat Pool is one of the world's largest marketing cooperatives. Its headquarters are in Regina, the province's capital and largest city.

Saskatchewan has over a third of all the farmland in Canada—more than any other province. Saskatchewan's farms are on its flat southern prairies, where most of the people live. Tall grain elevators rise in the hundreds of towns and villages that dot the fertile plains. More of the land is used to raise wheat than any other crop. In many areas, wheat fields extend to the horizon in all directions. Saskatchewan also ranks among the leading provinces and states in the production of barley, flaxseed, and rye. The farmers of Saskatchewan raise



Saskatchewan (*blue*) is 5th in Size among the Provinces.

large numbers of beef cattle as well as grain crops.

Southern Saskatchewan is much more than a rich farming region. Major oil fields were discovered there during the 1950's. These discoveries brought sudden changes to the prairies. Oil wells and drilling rigs became a common sight in the fields of golden wheat. Today, Saskatchewan produces about an eighth of Canada's petroleum, and is a leading oil producer of North America. Petroleum refining ranks as one of Saskatchewan's chief manufacturing industries. Saskatchewan's potash fields are the largest in the world. Potash mining is the fastest-growing mining industry in the province. Large-scale mining of potash, used in fertilizers, began during the early 1960's. In less than 10 years, Saskatchewan had become one of the world's leading producers of potash.

Northern Saskatchewan is rocky and covered with forests and lakes. It has the largest lakes in the province. Deposits of uranium there help make Saskatchewan a leading producer of this mineral. The region's commercially valuable trees include birch, jack pine, poplar, and spruce. Caribou, elk, and moose roam the rugged forests. Northern pike, pickerel, trout, and whitefish swim in the sparkling lakes and streams. Many sportsmen from Canada and the United States fly to this rough wilderness to hunt and fish. Indians, *métis* (persons of mixed Indian and white descent), and whites live in small, scattered communities in northern Saskatchewan. They earn their living by fishing, mining, trapping, and woodcutting.

The province took its name from the Saskatchewan River, named by the Cree Indians. They called the winding river *Kisiskadjewan* or *Kis-is-ska-tche-wan*, which means *fast flowing* or *river that turns around when it runs.*

For Saskatchewan's relationship to the other provinces of Canada, see CANADA; CANADA, GOVERNMENT OF; CANADA, HISTORY OF; PRAIRIE PROVINCES.

The contributors of this article are Stirling King, Executive Editor of The Star-Phoenix *of Saskatoon; and J. Howard Richards, Professor and Head of the Department of Geography at the University of Saskatchewan.*

FACTS IN BRIEF

Capital: Regina.

Government: *Parliament*—Senators, 6; Members of the House of Commons, 13. *Provincial Legislature*—Members of the legislative assembly, 61. *Counties*—none. *Voting Age*—18.

Area: 251,700 sq. mi. (651,900 km²), including 31,518 sq. mi. (81,631 km²) of inland water; fifth in size among the provinces. *Greatest Distances*—north-south, 760 mi. (1,223 km); east-west, 393 mi. (632 km).

Elevation: *Highest*—4,567 ft. (1,392 m) above sea level, in the Cypress Hills. *Lowest*—700 ft. (213 m), at Lake Athabasca.

Population: *1971 Census*—926,242, sixth among the provinces; density, 4 persons per sq. mi. (2 persons per km²); distribution, 53 per cent urban, 47 per cent rural.

Chief Products: *Agriculture*—barley, beef cattle, flaxseed, hay, hogs, rapeseed, wheat. *Mining*—coal, copper, natural gas, petroleum, potash, sand and gravel, sodium sulfate, uranium, zinc. *Manufacturing*—fabricated metal products; lumber and wood products; machinery; petroleum and coal products; printed materials; processed foods; stone, clay, and glass products. *Forest Products*—logs and bolts, poles, pulpwood. *Fur Industry*—beaver, coyote, mink. *Fishing Industry*—pickerel, pike, trout, whitefish.

Entered the Dominion with Alberta on Sept. 1, 1905, as the 8th and 9th provinces.

Regina Is Saskatchewan's Capital and Largest City.
Provincial Government of Saskatchewan

Lieutenant Governor of Saskatchewan represents Queen Elizabeth in the province. He is appointed by the governor general in council of Canada. The lieutenant governor's position is largely honorary, like that of the governor general.

Premier of Saskatchewan is the actual head of the provincial government. The province, like the other provinces and Canada itself, has a *parliamentary* form of government. The premier is a member of the legislative assembly, in which he is the leader of the majority party. The voters elect the premier of Saskatchewan as they do the other members of the assembly. The premier is paid $32,500 a year, in addition to the allowances that he gets as an assembly member. For a list of all the premiers of Saskatchewan, see the *History* section of this article.

The premier presides over the executive council, or cabinet. The council also includes ministers chosen by the premier from among his party's members in the legislative assembly. Each minister directs one or more departments of the provincial government. The executive council, like the premier of Saskatchewan, resigns if it loses the support of a majority of the legislative assembly.

Legislative Assembly of Saskatchewan is a one-house legislature that makes the provincial laws. It has 61 members elected from the province's 61 electoral districts. Regina has nine districts, Saskatoon has eight, and Moose Jaw has two.

The terms of the assembly members may last up to five years. However, the lieutenant governor, on the advice of the premier, may call for an election before the end of the five-year period. If he does so, all assembly members, including the premier, must run again for office.

Courts. The highest court in Saskatchewan is the court of appeal. It consists of the chief justice of Saskatchewan and four *puisne* (associate) judges. The court of queen's bench has a chief justice and seven puisne judges. In addition, 14 district court judges hold sessions in various parts of the province. All these justices and judges are appointed by the governor general in council. They can serve until the age of 75. Provincial authorities appoint 25 judges of magistrates' courts and 3 provincial magistrates.

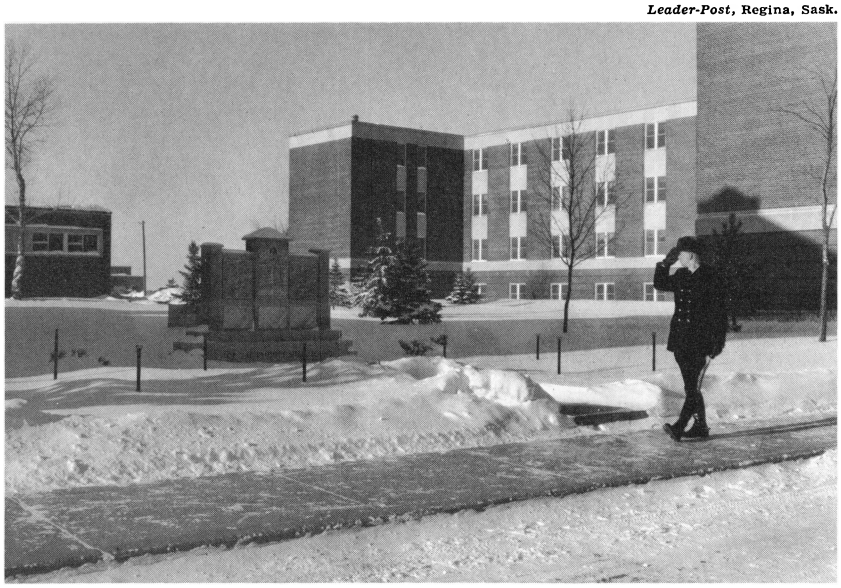
Local Government. There are no counties in Saskatchewan. The province has 12 cities and 130 towns, 358 villages, and 292 rural municipalities. Most of them are governed by councils, elected to terms of one to three years, and headed by a mayor or a *reeve*. These areas make up most of the southern two-fifths of Saskatchewan. The remainder of this southern region consists of nine unincorporated areas called local improvement districts.

The thinly populated northern three-fifths of Saskatchewan is called the Northern Administration District. All the communities in this part of the province have local governing groups. The northern region is administered by the provincial Department of Northern Saskatchewan. The department, which is based in La Ronge, provides municipal services to the communities.

Taxation. Taxes collected by the provincial government provide about two-thirds of its income. A retail sales tax used for education and health is the greatest source of tax income. Saskatchewan also collects taxes on gasoline, liquor, motor licenses, resources, and tobacco. The other third of Saskatchewan's income comes from federal-provincial tax-sharing agreements. By these agreements, the federal government collects individual and corporation income taxes for the province. The province also receives some federal grants.

Politics. The major political parties of Saskatchewan are the Liberal, New Democratic, and Progressive Conservative parties. The New Democratic Party was formerly known as the Co-operative Commonwealth

Leader-Post, Regina, Sask.



Headquarters of the training division of the Royal Canadian Mounted Police are in Regina. Recruits traditionally salute the Cenotaph, *left*, a memorial to Mounties who have died while in the service.

The Provincial Coat of Arms

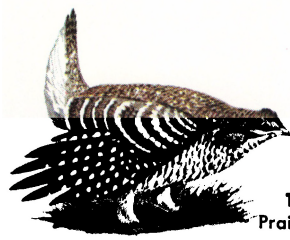
Symbols of Saskatchewan. On the coat of arms, the lion symbolizes the British Crown, and the three wheat sheaves, a resource of the province. Red stands for prairie fires, green for grass, and golden yellow for wheat fields. The arms were adopted in 1906. The province adopted a new flag in 1969. The flag's green stripe represents Saskatchewan's forests. The gold stripe stands for the province's wheat fields. The flag also displays Saskatchewan's coat of arms and the provincial flower, the prairie lily.

Federation (C.C.F.). The Progressive Conservative Party was originally named the Conservative Party, and today its members are usually called simply Conservatives.

The Liberals controlled the provincial government from 1905, when Saskatchewan became a province, until 1929. The Conservatives then took control, but lost to the Liberals in 1934. The C.C.F., a socialist party, defeated the Liberals in 1944 and held office for 20 years. Since the mid-1960's, the provincial government has been controlled by either the Liberal or the New Democratic party.

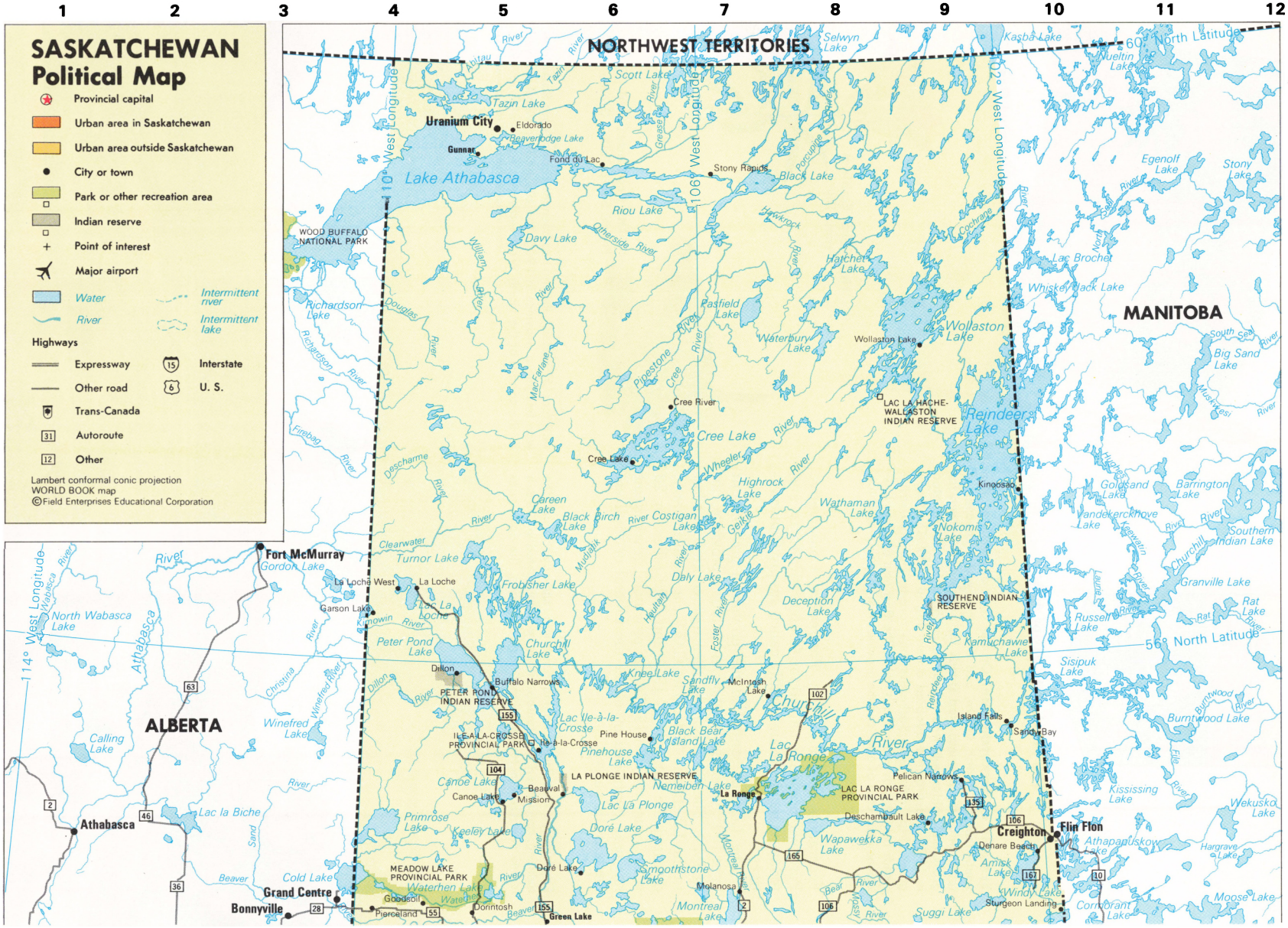
The Provincial Flag

The Floral Emblem
Prairie Lily



The Provincial Bird
Prairie Sharp-Tailed Grouse

Legislative Building in Regina stands in a landscaped park. The building, constructed of Manitoba stone, was completed in 1912. It is 542 feet (165 meters) long and has 265 rooms. The dome rises 188 feet (57 meters). Regina has been the capital since Saskatchewan became a province in 1905. The city had previously served as the capital of the North West Territories from 1883 to 1905.
Provincial Government of Saskatchewan


SASKATCHEWAN
Political Map
Provincial capital
Urban area in Saskatchewan
Urban area outside Saskatchewan
City or town
Park or other recreation area
Indian reserve
Point of interest
Major airport
Water
River
Intermittent river
Intermittent lake
Highways
Expressway
Other road
Trans-Canada
Autoroute
Other
Interstate
U. S.
Lambert conformal conic projection
WORLD BOOK map
©Field Enterprises Educational Corporation
NORTHWEST TERRITORIES
MANITOBA
ALBERTA
Uranium City
Eldorado
Gunnar
Fond du Lac
Stony Rapids
Lake Athabasca
Black Lake
Riou Lake
Davy Lake
WOOD BUFFALO NATIONAL PARK
Richardson Lake
Wollaston Lake
Wollaston Lake
LAC LA HACHE-WOLLASTON INDIAN RESERVE
Reindeer Lake
Cree River
Cree Lake
Cree Lake
Kinoosao
Fort McMurray
La Loche West
La Loche
Garson Lake
Lac La Loche
Peter Pond Lake
Churchill Lake
Frobisher Lake
Turnor Lake
Black Birch Lake
Costigan Lake
Careen Lake
Wathaman Lake
Highrock Lake
Daly Lake
Deception Lake
SOUTHEND INDIAN RESERVE
Nokomis Lake
Kamuchawie Lake
Dillon
Buffalo Narrows
PETER POND INDIAN RESERVE
Knee Lake
Sandfly Lake
McIntosh Lake
Island Falls
Sandy Bay
Lac Ile-a-la-Crosse
ILE-A-LA-CROSSE PROVINCIAL PARK
Ile-a-la-Crosse
Pine House
Black Bear Island Lake
Pinehouse Lake
Lac La Ronge
La Ronge
LA PLONGE INDIAN RESERVE
Pelican Narrows
LAC LA RONGE PROVINCIAL PARK
Deschambault Lake
Canoe Lake
Beauval
Mission
Canoe Lake
Nemeiben Lake
Primrose Lake
Keeley Lake
Lac La Plonge
Doré Lake
Wapawekka Lake
Creighton
Flin Flon
Denare Beach
Athabasca
Lac la Biche
Calling Lake
Winefred Lake
North Wabasca Lake
MEADOW LAKE PROVINCIAL PARK
Waterhen Lake
Goodsoil
Pierceland
Donntosh
Green Lake
Doré Lake
Smoothstone Lake
Molanosa
Montreal Lake
Suggi Lake
Sturgeon Landing
Cormorant Lake
Grand Centre
Bonnyville
Cold Lake
Beaver River
Sand River
Clearwater River
Athabasca River
Churchill River
Reindeer River
Wollaston Lake
Lac Brochet
Whiskey Jack Lake
Egenolf Lake
Stony Lake
Big Sand Lake
Goldsand Lake
Barrington Lake
Southern Indian Lake
Granville Lake
Rat Lake
Burntwood Lake
Sisipuk Lake
Kississing Lake
Wekusko Lake
Athapapuskow Lake
Hargrave Lake
Moose Lake
Amisk Lake
Windy Lake
Island Falls
Wathaman Lake
Highrock Lake
Lac Brochet
Whiskey Jack Lake
Egenolf Lake
Stony Lake
Big Sand Lake
Goldsand Lake
Barrington Lake
Southern Indian Lake
Granville Lake
Rat Lake
Burntwood Lake
Sisipuk Lake
Kississing Lake
Wekusko Lake
Athapapuskow Lake
Hargrave Lake
Moose Lake
Amisk Lake
Windy Lake
Island Falls
Wathaman Lake
Highrock Lake
60° North Latitude
56° North Latitude
102° West Longitude
106° West Longitude
110° West Longitude
114° West Longitude
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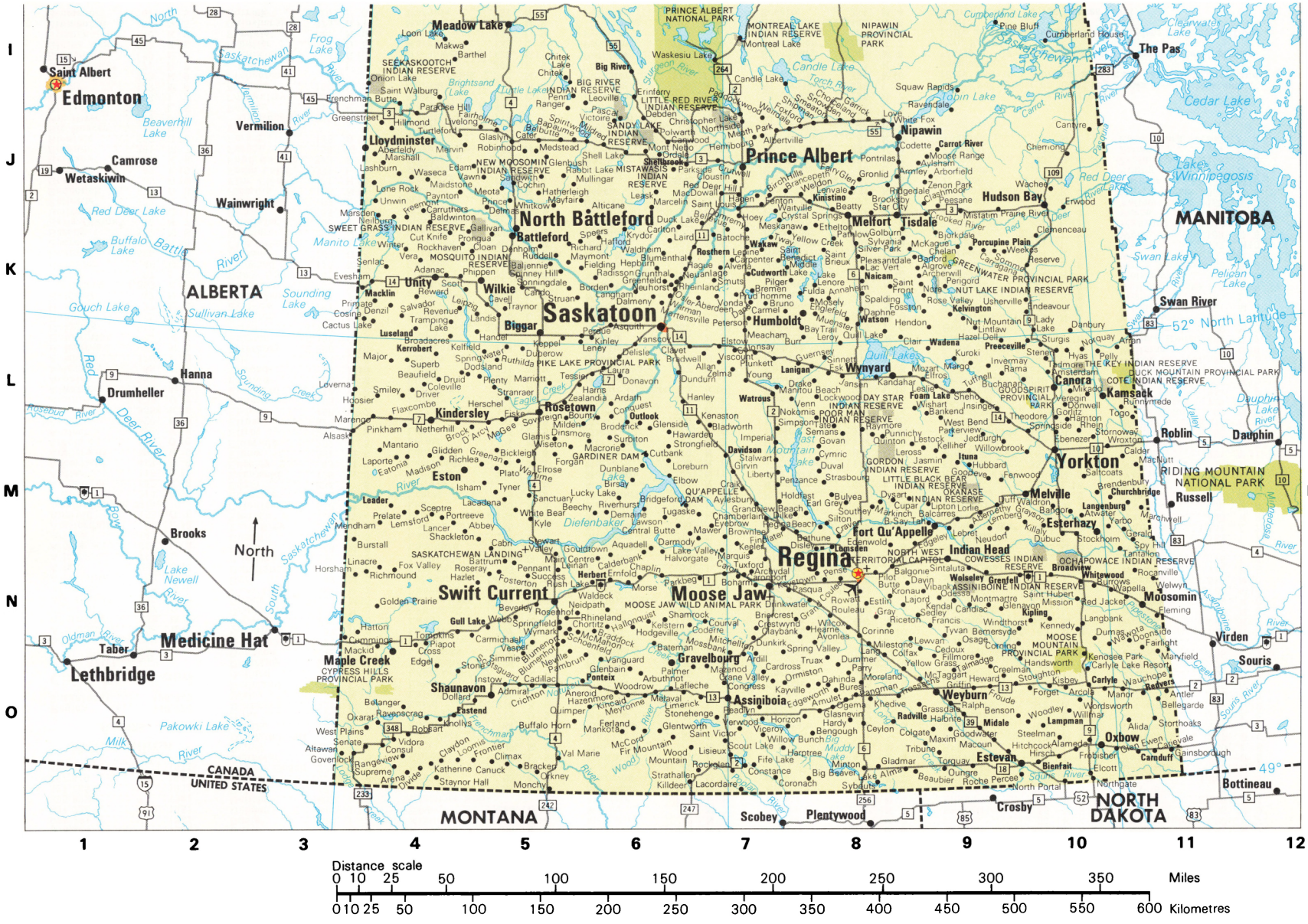
Saskatoon
Regina
Prince Albert
North Battleford
Swift Current
Moose Jaw
Yorkton
Meadow Lake
The Pas
Nipawin
Lloydminster
Edmonton
Saint Albert
Vermilion
Camrose
Wetaskiwin
Wainwright
Hanna
Drumheller
Brooks
Medicine Hat
Taber
Lethbridge
Maple Creek
Shaunavon
Assiniboia
Gravelbourg
Weyburn
Estevan
Melfort
Tisdale
Hudson Bay
Kindersley
Rosetown
Battleford
Biggar
Unity
Wilkie
Humboldt
Wynyard
Melville
Esterhazy
Fort Qu'Appelle
Indian Head
Kamsack
Canora
Swan River
Dauphin
Roblin
Russell
Virden
Souris
Moosomin
Oxbow
Carnduff
Bienfait
Bottineau
Crosby
Scobey
Plentywood
Northgate
North Portal
Estevan
Carlyle
Redvers
Antler
Wauchope
Kipling
Whitewood
Broadview
Grenfell
Wolseley
Langenburg
Churchbridge
Esterhazy
Melville
Yorkton
Canora
Kamsack
Porcupine Plain
Preeceville
Hudson Bay
Melfort
Tisdale
Nipawin
Carrot River
Prince Albert
Shellbrook
Big River
Meadow Lake
Loon Lake
Makwa
Barthel
Chitek Lake
Waskesiu Lake
Montreal Lake
Pine Bluff
Cumberland House
Cumberland Lake
Squaw Rapids
Ravendale
Love
White Fox
Codette
Parkside
Smeaton
Choiceland
Garrick
Torch River
Candle Lake
Big River
Leoville
Pascal
Victoire
Debden
Christopher Lake
Northside
Meath Park
Albertville
Hemboldt
Ordale
Shell Lake
Glaslyn
Robinhood
Medstead
Marshall
Lashburn
Waseca
Edam
Vawn
Sandwith
Cochin
Meota
Maidstone
Paynton
Turtleford
Fairholme
Livelong
Greenstreet
Frenchman Butte
Saint Walburg
Onion Lake
Seekaskootch Indian Reserve
Frog Lake
Saskatchewan River
Beaverhill Lake
Vermilion River
Red Deer Lake
Buffalo Lake
Battle River
Manito Lake
Gouch Lake
Sullivan Lake
Sounding Lake
Sounding Creek
Red Deer River
Rosebud River
Eagle Creek
Dauphin Lake
Swan Lake
Pelican Lake
Lake Winnipegosis
Cedar Lake
Clearwater Lake
Carrot River
Torch River
Candle Lake
Cumberland Lake
Pasquia Hills
Porcupine Hills
Duck Mountain
Riding Mountain National Park
Prince Albert National Park
Nipawin Provincial Park
Greenwater Provincial Park
Nut Lake Indian Reserve
Key Indian Reserve
Cote Indian Reserve
Duck Mountain Provincial Park
Goodspirit Provincial Park
Day Star Indian Reserve
Poor Man Indian Reserve
Gordon Indian Reserve
Little Black Bear Indian Reserve
Okanese Indian Reserve
Assiniboine Indian Reserve
Cowessess Indian Reserve
Ochapowace Indian Reserve
Moose Mountain Provincial Park
Cypress Hills Provincial Park
Pike Lake Provincial Park
Gardiner Dam
Qu'Appelle Dam
Diefenbaker
Lake Newell
Pakowki Lake
Milk River
Oldman River
South Saskatchewan River
Saskatchewan River
Qu'Appelle River
Assiniboine River
Souris River
Whitemud River
Swift Current Creek
Wood River
Frenchman River
Big Muddy Lake
Big Muddy Creek
Old Wives Lake
Chaplin Lake
Reed Lake
Last Mountain Lake
Buffalo Horn
Val Marie
Frontier
Climax
Gull Lake
Webb
Eastend
Robsart
Consul
Vidora
Claydon
Coomis
Senate
Altawan
Govenlock
Rangeview
Supreme
Arena
Katherine
Canuck
Bracken
Okfney
Staynor Hall
Monchy
Strathallen
Killdeer
Lacordaire
Coronach
Big Beaver
Fife Lake
Harptree
Minton
Gladmar
Torquay
Oungre
Roche Percee
Beaubier
Sybouth
Alma
Wood Mountain
Rockglen
Constance
Scout Lake
Willow Bunch
Saint Victor
Glentworth
Viceroy
Bengough
Ceylon
Radville
Halbrite
Midale
Goodwater
Macoun
Tribune
Maxim
Steelman
Lampman
Alida
Storthoaks
Gainsborough
Carievale
Glen Ewen
Hirsch
Frobisher
Elcott
Northgate
Bienfait
Carnduff
Oxbow
Estevan
Weyburn
Assiniboia
Gravelbourg
Shaunavon
Maple Creek
Cypress Hills Provincial Park
Lethbridge
Taber
Medicine Hat
Brooks
Drumheller
Hanna
Wetaskiwin
Camrose
Lloydminster
Saint Albert
Edmonton
Wainwright
Vermilion
Alberta
Manitoba
North Dakota
Montana
Canada
United States
49° North Latitude
52° North Latitude
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Distance scale
0 10 25 50 100 150 200 250 300 350 Miles
0 10 25 50 100 150 200 250 300 350 400 450 500 550 600 Kilometres

Population

926,242 ...Census..1971
955,344 ....."....1966
925,181 ....."....1961
831,728 ....."....1951
895,992 ....."....1941
921,785 ....."....1931
757,510 ....."....1921
492,432 ....."....1911

Metropolitan Areas

Regina 140,734
Saskatoon† 126,449

Cities, Towns, and Villages

Abbey .....246..M 4
Aberdeen .....288..K 7
Abernethy ....253..M 9
Admiral .....77..O 5
Air Ronge* ...239..G 7
Alameda .....370..O 10
Albertville .....80..J 7
Alida .....230..O 11
Allan .....712..L 7
Alsask .....819..L 3
Alvena .....143..K 7
Amsterdam .....51..L 10
Aneroid .....163..O 6
Anglo-Rouyon Mine Site* .....214..G 9
Annaheim .....182..K 8
Antler .....115..O 11
Arborfield .....418..J 9
Archerwill ....302..K 9
Arcola .....539..O 10
Arelee* .....52..K 5
Arran .....120..L 10
Asquith .....355..K 6
Assiniboia ..2,675..O 7
Atwater .....60..M 10
Avonlea .....391..N 8
Aylesbury .....88..M 7
Aylsham .....170..J 9
Balcarres ....678..M 9
Baldwinton ....44..K 4
Balgonie .....518..N 8
Bangor .....69..M 10
Bankend .....77..L 9
Bateman .....47..N 6
Battleford ..1,803..K 5
Beatty .....97..J 8
Beaubier .....46..O 9
Beauval .....436..G 6
Beaver Lake* ..116..N 10
Beechy .....342..M 6
Belle Plaine* ..62..N 7
Bellegarde ....79..O 11
Bellevue .....122..K 7
Bengough ....650..O 8
Benson .....83..O 10
Bertwell* .....52..K 10
Bethany* .....121..K 6
Bethune .....291..M 7
Bienfait .....823..O 10
Big Beaver ....73..O 8
Big River .....836..I 6
Biggar ....2,607..L 5
Birch Hills ...696..J 7
Birsay .....123..M 6
Bjorkdale ....223..K 9
Black Lake* ...471..B 7
Bladworth ....125..L 7
Blaine Lake* .671..K 6
Blumenheim* ...40..K 6
Blumenhof .....50..N 5
Blumenort .....67..N 5
Dana .....78..K 7
D'Arcy .....44..L 5
Davidson ...1,043..M 7
Davin .....50..N 8
Davis* .....40..J 7
Debden .....340..J 6
Delisle .....653..L 6
Delmas .....161..J 5
Demaine .....71..M 6
Denare Beach .235..H 10
Denholm .....71..K 5
Denzil .....287..K 4
Deschambault Lake .....127..H 9
Dilke .....130..M 7
Dinsmore ....421..M 6
Disley .....53..N 8
Dodsland ....404..L 4
Dollard .....92..O 5
Domremy ....208..K 7
Donavon .....43..L 6
Doré Lake ....71..H 6
Dorintosh ....87..H 5
Drake .....238..L 8
Drinkwater ...118..N 8
Dubue .....153..M 10
Duck Lake ...584..K 7
Duff .....90..M 9
Dunblane .....57..M 6
Dundurn ....354..L 6
Duval .....133..M 8
Dysart .....243..M 8
Earl Grey ....243..M 8
Eastend .....784..O 4
Eatonia .....610..M 4
Ebenezer ....140..L 10
Edam .....334..J 5
Edenwold ....129..M 8
Edgeley .....43..M 9
Elbow .....361..M 6
Eldorado ....289..A 5
Elfros .....253..L 9
Elrose .....573..M 5
Elstow .....150..L 7
Endeavour ....193..K 10
Englefeld ....218..K 8
Ernfold .....100..N 6
Erwood .....94..J 10
Esk .....52..L 8
Esterhazy ...2,896..M 10
Estevan ....9,150..O 10
Eston .....1,418..M 4
Evesham .....63..K 4
Eyebrow .....181..M 7
Fairholme ....51..J 5
Fairlight ....127..N 11
Fairy Glen ....42..J 8
Fenwood .....112..M 9
Ferland .....109..O 6
Fife Lake .....83..O 7
Fillmore ....396..N 9
Findlater .....96..M 7
Fiske .....85..L 5
Flaxcombe ....99..L 4
Fleming .....183..N 11
Flin Flon** ..471..H 10
Foam Lake ..1,331..L 9
Fond du Lac ..328..B 5
Forgan .....50..M 5
Forget .....118..O 10
Fort Qu'Appelle 1,606..M 9
Fosston .....119..K 9
Fox Valley ....489..N 4
Francis .....159..N 9
Frenchman Butte .....86..I 4
Frobisher ....245..O 10
Frontier .....249..O 5
Furdale* .....144..K 6
Gainsborough ..375..O 11
Garrick .....120..J 8
Kindersley ..3,451..L 4
Kinistino ....767..J 8
Kinley .....74..L 6
Kinoosao .....95..E 10
Kipling .....927..N 10
Kisbey .....260..O 10
Klemmer Sub-division* ....89..C 9
Kronau .....63..N 8
Krydor .....136..K 6
Kuroki .....167..L 9
Kyle .....509..M 5
Lac Vert .....111..K 8
Lacadena .....84..M 5
Lafleche ....715..O 6
Laird .....218..K 6
Lajord .....61..N 8
Lake Alma ....173..O 8
Lake Lenore ..392..K 8
La Loche ...1,136..F 4
Lampman ....830..O 10
Lancer .....199..M 4
Landis .....297..K 5
Lang .....183..N 8
Langbank .....52..N 10
Langenburg ..1,236..M 10
Langham ....535..K 6
Lanigan ...1,430..L 8
Laporte .....50..M 4
La Ronge ....906..G 7
Lashburn ....494..J 4
Laura .....70..L 6
Lawson .....60..M 6
Leader .....1,105..M 4
Leask .....439..J 6
Lebret .....278..M 9
Leipzig .....87..K 5
Lemberg .....409..M 9
Lemsford .....48..M 4
Leoville .....399..I 6
Leross .....91..M 9
Leroy .....435..L 8
Leslie .....87..L 9
Lestock .....452..M 9
Liberty .....141..M 7
Limerick ....178..O 7
Lintlaw .....212..L 9
Lipton .....401..M 9
Lisieux .....51..O 7
Livelong .....126..J 5
Lloyd-minster‡ ..3,953..J 4
Lockwood .....60..L 8
Lone Rock ....120..J 4
Loon Lake ....348..I 4
Loreburn ....252..M 6
Love .....133..J 8
Loverna .....55..L 3
Lucky Lake ...378..M 6
Lumsden ....900..N 8
Luseland ....728..L 4
MacDowall ....173..J 7
Macklin .....829..K 4
MacNutt .....184..M 11
Macoun .....172..O 9
Macrorie ....120..M 6
Madison .....58..M 4
Maidstone ....691..J 4
Main Centre ...53..N 6
Major .....164..L 4
Makwa .....126..I 5
Manitou Beach 118..L 7
Mankota .....424..O 6
Manor .....409..O 10
Mantario .....48..M 4
Maple Creek 2,268..N 4
Marcelin ....306..J 6
Marchwell ....129..M 11
Marengo .....133..L 4
Margo .....225..L 9
Markinch .....80..M 8
Marquis .....131..N 7
Marsden .....241..J 4
Marshall .....195..J 4
Martensville ..870..K 6
Maryfield ....408..N 11
Matador* .....42..N 5
Mawer .....52..M 7
Mayfair .....134..J 6
Maymont .....167..K 5
Mazenod .....73..O 7
McCord .....68..O 6
McKague .....91..K 9
McLean* .....178..N 8
McTaggart ....58..O 9
Meacham ....186..L 7
Meadow Lake 3,435..I 5
Meath Park ...251..J 7
Medstead .....172..J 7
Melaval .....51..O 6
Melfort ....4,725..J 8
Melville ....5,375..M 10
Mendham ....163..M 4
Meota .....233..J 5
Mervin .....198..J 4
Meyronne .....142..O 6
Midale .....647..O 9
Middle Lake ..292..K 7
Mikado .....90..L 10
Milden .....239..L 6
Mildred .....54..J 6
Milestone ....483..N 8
Minto Park* ....89..E 5
Minton .....215..O 8
Mistatim .....165..J 9
Molanosa .....213..H 7
Mont Nebo ....53..J 6
Montmartre ...510..N 9
Moose Jaw .31,854..N 7
Moosomin ...2,407..N 11
Morse .....455..N 6
Mortlach* ....310..N 7
Mossbank ....460..N 7
Mozart .....93..L 9
Muenster ....280..K 8
Naicam .....711..K 8
Neilburg .....298..K 4
Nesbit Heights* 93..K 10
Netherhill .....67..L 4
Neuanlage ....107..K 6
Neudorf .....469..M 9
Neuhorst .....151..K 6
Neville .....154..N 5
Nipawin ....4,057..J 8
Nokomis .....533..L 8
Norquay .....513..L 10
North Battle-ford ....12,698..K 5
North Portal ..189..O 10
Northside .....41..J 7
Nut Mountain ..82..K 9
Odessa .....224..N 9
Ogema .....457..O 8
Okla* .....46..K 9
Orkney .....41..O 5
Ormiston ....173..O 7
Osage .....55..N 9
Osler .....182..K 6
Oungre .....68..O 9
Outlook ....1,767..L 6
Oxbow ....1,380..O 10
Paddockwood ..230..J 7
Palmer .....58..O 7
Pambrun .....91..N 6
Pangman ....242..O 8
Paradise Hill .344..J 4
Parkbeg .....70..N 7
Parkside .....112..J 6
Parry .....67..O 8
Pathlow .....58..K 8
Paynton .....204..J 4
Pelican Narrows ....265..G 9
Pelly .....426..L 10
Pennant .....215..N 5
Pense .....270..N 8
Penzance .....81..M 7
Perdue .....411..L 6
Perigord .....52..K 9
Peterson .....62..K 7
Piapot .....160..N 4
Pierceland ....271..H 4
Pilger .....109..K 7
Pilot Butte ...403..N 8
Pine House ...427..G 6
Plato .....66..M 5
Pleasant Heights* ....86..M 5
Pleasantdale ..153..K 8
Plenty .....208..L 5
Plunkett .....152..L 7
Ponteix .....786..O 6
Porcupine Plain .....830..K 9
Portreeve .....58..M 4
Prairie River ..65..J 9
Preeceville ..1,118..L 10
Prelate .....407..M 4
Primate .....82..K 4
Prince Albert ...28,464..J 7
Prud'homme ..260..K 7
Punnichy ....451..L 8
Qu'Appelle* ...451..N 9
Quill Lake ....566..L 8
Quinton .....195..L 8
Rabbit Lake ..206..J 5
Radisson ....416..K 6
Radville ....1,024..O 8
Rama .....188..L 9
Raymore .....523..L 8
Red Wing Terrace* ....140..J 4
Redvers ....846..O 11
Regina ....139,469..N 8
Regina Beach .334..M 8
Reserve .....153..K 10
Revenue .....46..K 4
Reward .....76..K 4
Rhein .....295..L 10
Rheinland ....47..K 6
Rhineland ....84..N 5
Riceton .....112..N 8
Richlea .....49..M 5
Richmound ...208..N 4
Ridgedale ....169..J 8
Riverhurst ...264..M 6
Riverside* ....89..N 5
Robsart .....52..O 4
Rocanville ...891..N 11
Roche Percee ..167..O 10
Rockglen .....550..O 7
Rockhaven ....53..K 4
Rose Valley ..591..K 9
Rosetown ...2,614..L 5
Rosthern ...1,431..K 7
Rouleau .....395..N 8
Runnymede ....71..L 10
Rush Lake ....162..N 6
Ruskin Place* ..41..J 5
Ruthilda .....48..L 5
St. Benedict ..193..K 7
St. Brieux ....367..K 8
St. Denis* ....51..K 6
St. Front .....94..K 8
St. Gregor* ....125..K 8
St. Louis .....387..J 7
St. Victor .....85..O 7
St. Walburg ...656..I 4
Saltcoats .....509..M 10
Salvador .....77..K 4
Sanctuary .....46..M 5
Sanderson* ....57..G 7
Sandy Bay ...494..G 10
Saskatoon ..126,449..K 6
Sceptre .....234..M 4
Schoenfeld ....65..N 5
Scott .....254..K 4
Sedley .....268..N 9
Semans .....331..L 8
Senlac .....94..K 4
Shackleton ....55..M 5
Shamrock ....105..N 6
Shaunavon ..2,244..O 5
Sheho .....320..L 9
Shell Lake ....255..J 6
Shellbrook ..1,048..J 6
Shipman .....60..J 8
Silton .....59..M 8
Simmie .....100..N 5
Simpson .....239..L 7
Sintaluta ....272..N 9
Smeaton .....315..J 8
Smiley .....124..L 4
Snowden .....87..J 8
Somme .....82..K 9
Sonningdale ..106..K 5
South Tisdale Subdivision* ..63..K 8
Southey .....548..M 8
Sovereign .....91..L 5
Spalding .....329..K 8
Speers .....117..K 6
Spiritwood ...719..J 6
Spring Valley ..71..N 7
Springfield ....41..N 5
Springside ....350..L 10
Springwater ....99..L 5
Spruce Lake* ..106..J 4
Spy Hill .....384..M 11
Stalwart .....45..M 7
Star City .....543..J 8
Stenen .....225..L 10
Stewart Valley 138..N 5
Stockholm ....357..M 10
Stony Beach* ..53..N 8
Stony Lake* ...43..J 5
Stony Rapids .147..B 7
Storthoaks ....177..O 11
Stoughton ....751..O 10
Stranraer .....66..L 5
Strasbourg ....759..M 8
Strongfield ...110..M 6
Sturgis .....617..L 10
Success .....101..N 5
Summerberry* ..41..N 9
Swan Plain* ...51..J 10
Swift Current ..15,415..N 5
Sybouts .....46..O 8
Sylvania .....125..K 8
Tadmore .....56..L 10
Tantallon ....174..N 10
Tessier .....40..L 6
Theodore ....434..L 9
Timber Bay* ..174..I 8
Tisdale .....2,798..J 8
Togo .....227..L 11
Tompkins .....353..N 4
Torquay .....377..O 9
Tramping Lake 241..K 4
Tribune .....136..O 9
Trossachs .....57..O 8
Truax .....55..O 8
Tuffnell .....42..L 9
Tugaske .....196..M 7
Turnor Lake* .276..F 4
Turtleford ....419..J 4
Tuxford .....153..N 7
Tway .....67..K 7
Tweedsmuir* ...80..J 7
Tyvan .....86..N 9
Unity .....2,294..K 4
Uranium City ....1,867..A 5
Usherville ....42..K 10
Val Marie ....307..O 5
Valparaiso* ....50..J 8
Vanguard ....315..O 6
Vanscoy .....244..L 6
Vawn .....119..J 5
Veregin .....197..L 10
Verwood .....56..O 7
Vibank .....275..N 9
Viceroy .....152..O 7
Victoire .....70..J 6
Viscount .....395..L 7
Vonda .....258..K 7
Wadena ....1,382..L 9
Wakaw .....1,009..K 7
Waldeck .....242..N 5
Waldheim ....606..K 6
Waldron .....80..M 10
Wapella .....518..N 10
Warman .....781..K 6
Waseca .....115..J 4
Waskesiu Lake .....154..I 7
Watrous ....1,541..L 7
Watson .....840..K 8
Wawota .....536..N 10
Webb .....105..N 5
Weekes .....183..K 9
Weirdale .....108..J 7
Weldon .....254..J 8
Welwyn .....231..N 11
West Bend ....41..L 9
Westview* .....99..M 10
Weyburn ....8,815..O 9
White Bear ....82..M 5
White City* ...129..N 8
White Fox ....354..J 8
Whitewood ..1,098..N 10
Wilcox .....189..N 8
Wilkie .....1,642..K 5
Willmar .....57..O 10
Willow Bunch 482..O 7
Willowbrook ....70..M 10
Windthorst ...188..N 10
Wiseton .....181..M 5
Wishart .....269..L 9
Wollaston Lake 115..C 9
Wolseley ....975..N 9
Wood Mountain 86..O 6
Woodrow .....73..O 6
Wroxton .....92..M 10
Wymark .....199..N 5
Wynyard ....1,932..L 8
Yarbo .....160..M 10
Yellow Creek ..163..K 7
Yellow Grass ..500..O 8
Yorkton ....13,430..M 10
Young .....496..L 7
Zealandia ....155..L 5
Zelma .....51..L 7
Zenon Park ...346..J 9

*Does not appear on map; key shows general location.
†City and metropolitan area have same boundary and population.
**City on Saskatchewan-Manitoba border; total population, 9,344.
‡City on Saskatchewan-Alberta border; total population, 8,691.
Source: Latest census figures (1971).

Boharm .....43..N 7
Borden .....187..K 6
Bounty .....49..L 6
Bracken .....64..O 5
Bradwell .....100..L 7
Bredenbury ...472..M10
Briercrest ....130..N 7
Broadview ....959..N10
Brock .....205..L 5
Broderick ....115..L 6
Bromhead* ....58..O10
Brownlee .....121..M 7
Bruno .....728..K 7
Buchanan ....442..L10
Buffalo
Narrows ....794..F 5
Bulyea .....109..M 8
Burstall .....507..M 3
Cabri .....737..N 5
Cadillac .....217..O 5
Calder .....186..M10
Camsell
Portage* ....87..A 5
Candiac .....75..N 9
Cando .....193..K 5
Canoe Lake ...138..G 5
Canora .....2,603..L10
Canwood .....325..J 6
Carievale .....229..O11
Carlton .....52..K 6
Carlyle .....1,101..O10
Carmel .....90..K 7
Carnduff ....1,075..O11
Caron .....96..N 7
Carragana ....137..K 9
Carrot River ..953..J 9
Cedoux .....48..N 9
Central Butte .522..M 6
Ceylon .....279..O 8
Chamberlain ..161..M 7
Chaplin .....368..N 6
Chelan .....101..K 9
Chitek Lake ..131..I 5
Choiceland ...456..J 8
Chortitz .....65..N 5
Christopher
Lake .....143..J 7
Churchbridge .973..M10
Clair .....86..L 8
Climax .....341..O 5
Cochin .....163..J 5
Coderre .....161..N 7
Codette .....175..J 8
Coleville .....482..L 4
Colfax .....43..N 9
Colgate .....59..O 9
Collacott
Subdivision* 308..M10
Colonsay .....526..L 7
Congress .....50..O 7
Connaught
Heights* ...166..J 5
Conquest .....261..L 6
Consul .....205..O 4
Corning .....74..N10
Coronach .....379..O 7
Courval .....46..N 7
Craik .....503..M 7
Crane Valley ..84..O 7
Craven .....126..M 8
Cree Lake .....47..D 6
Creelman .....197..O 9
Creighton ...1,857..H10
Crooked River .106..J 9
Crutwell .....71..J 7
Crystal Springs .59..K 7
Cudworth .....799..K 7
Cupar .....573..M 9
Cut Knife ....560..K 4
Cutbank .....217..M 6
Dafoe* .....46..L 8
Dalmeny .....417..K 6
Gerald .....174..M10
Girvin .....86..M 7
Gladmar .....131..O 8
Glaslyn .....357..J 5
Glen Ewen ....223..O10
Glenavon .....340..N 9
Glenmere* .....50..N 7
Glenside .....94..L 6
Glentworth ...126..O 6
Glidden .....71..M 4
Golden Prairie 144..N 4
Goodeve .....169..M 9
Goodsoil .....219..H 4
Goodwater .....71..O 9
Gorlitz .....94..L10
Govan .....354..M 8
Grand Coulee .131..N 8
Gravelbourg 1,428..O 6
Gray .....59..N 8
Grayson .....260..M10
Green Acres* ..117..J 6
Green Lake ...450..H 5
Greenfeld .....54..K 6
Grenfell ....1,350..N10
Griffin .....90..O 9
Gronlid .....138..J 8
Grunthal .....83..K 6
Guernsey .....142..L 8
Gull Lake ..1,156..N 5
Hafford .....580..K 6
Hague .....431..K 6
Halbrite .....166..O 9
Handel .....72..L 5
Hanley .....390..L 6
Hardy .....42..O 8
Harris .....254..L 6
Hawarden ....190..L 6
Hazel Dell ....105..L 9
Hazenmore ....127..O 6
Hazlet .....198..N 5
Hendon .....69..K 9
Henribourg ....59..J 7
Hepburn .....305..K 6
Herbert ....1,024..N 6
Herschel .....89..L 5
Heward .....79..O 9
Hitchcock .....91..O 9
Hodgeville ....399..N 6
Hoey .....95..J 7
Holdfast .....399..M 7
Hubbard .....119..M 9
Hudson Bay 1,971..J 10
Hughton* .....57..L 5
Humboldt ...3,881..K 8
Hyas .....215..L10
Ile à-la-
Crosse .....908..G 5
Imperial .....486..M 7
Indian Head 1,810..N 9
Insinger .....72..L 9
Invermay .....412..L 9
Ituna .....960..M 9
Jan Bay* .....74..H 9
Jan Lake* .....57..H 9
Jansen .....241..L 8
Jedburgh .....64..M 9
Kamsack ...2,783..L10
Kandahar .....80..L 8
Katepwa
Beach* .....44..M 9
Kayville .....84..O 8
Keeler .....58..M 7
Kelliher .....460..M 9
Kelvington ..1,053..K 9
Kenaston .....402..L 7
Kendal .....90..N 9
Kennedy .....264..N10
Kenosee Park ..103..N10
Kerrobert ...1,180..L 4
Khedive .....91..O 8
Killaly .....139..M10
Kincaid .....306..O 6

SASKATCHEWAN / *People*

The 1971 Canadian census reported that Saskatchewan had 926,242 persons. The population of the province had decreased 3 per cent from the 1966 figure of 955,344.

Over one-half of the people of Saskatchewan live in cities and towns. Saskatchewan has two Census Metropolitan Areas as defined by Statistics Canada, Regina and Saskatoon. The province has seven cities with populations of more than 10,000. They are, in order of size, Regina, Saskatoon, Moose Jaw, Prince Albert, Swift Current, Yorkton, and North Battleford. Over a fourth of the province's people live in Regina and Saskatoon. See the separate articles on the cities and towns of Saskatchewan listed in the *Related Articles* at the end of this article.

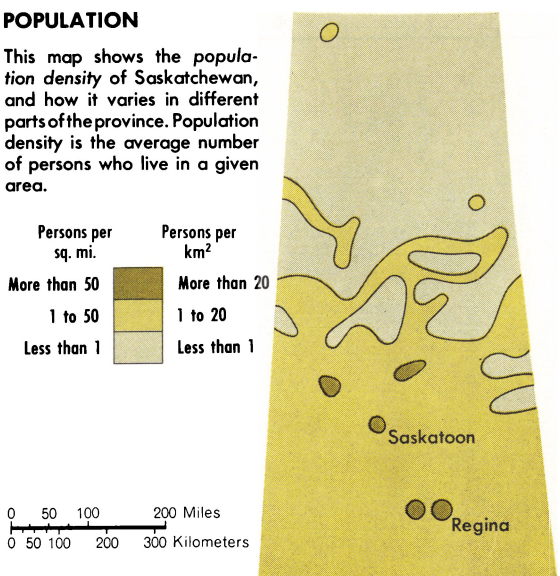
About 85 per cent of Saskatchewan's people were born in Canada. Most of those born in other countries came from Great Britain, the United States, or Russia. About 40 per cent of the people have English, Irish, or Scottish ancestors. Other groups, in order of size, include those of German, Ukrainian, Scandinavian, or French descent.

Saskatchewan has about 40,500 Indians. Most of the province's Indians live on reservations. Several thousand *métis* (persons of mixed Indian and white descent) live in the thinly populated northern part of the province.

More of Saskatchewan's people belong to the United Church of Canada than to any other religious body. Other large church groups, in order of size, include Roman Catholics, Lutherans, and members of the Anglican Church of Canada.

POPULATION

This map shows the *population density* of Saskatchewan, and how it varies in different parts of the province. Population density is the average number of persons who live in a given area.



WORLD BOOK maps

National Film Board of Canada

Downtown Regina attracts shoppers from surrounding areas. Over half of Saskatchewan's people live in cities and towns. Over a fourth of the people live in Regina and Saskatoon.

SASKATCHEWAN / *Education*

Schools. Missions and churches provided the only schooling in the Saskatchewan region until 1884. That year, the federal government started a system of public education. By 1892, the region had 249 schools. Attendance was required between the ages of 7 and 12, for at least 12 weeks a year.

In 1907, the legislative assembly provided by law for high schools. Until then, many schools taught both grade and high school subjects. In 1944, the province began to organize public education under the Larger School Units Act. Over 4,800 school districts have been organized into about 60 larger administrative units.

Saskatchewan schools are supervised by the provincial department of education, headed by the minister of education. The province has about 1,000 public and separate schools. *Separate schools* are tax-supported schools operated by a religious group but controlled by separate school boards and the department of education. Children between the ages of 7 and 16 must attend school. For the number of students and teachers in Saskatchewan, see EDUCATION (table). The province has two degree-granting universities—the University of Regina and the University of Saskatchewan (see REGINA, UNIVERSITY OF; SASKATCHEWAN, UNIVERSITY OF).

Libraries. The first public library in Saskatchewan was established in Regina in 1908. Today, the province has over 275 public libraries. More than 75 special libraries, including the Legislative Library and the University of Saskatchewan and University of Regina libraries, serve business people, students, educators, and government officials.

Museums. The Saskatchewan Museum of Natural History, established in Regina in 1906, has exhibits on animals and plants of the province, and on archaeology, ethnology, and geology. The Royal Canadian Mounted Police has a historical museum in Regina. The Norman Mackenzie Art Gallery is in Regina. The Western Development Museum in Saskatoon, with branches in North Battleford and Yorkton, has farm equipment exhibits.

Royal Canadian Mounted Police Museum in Regina

SASKATCHEWAN / *A Visitor's Guide*

More than a hundred historic markers honor battlefields, forts, missions, and other reminders of Saskatchewan's colorful past. Many markers identify early trails used by hunters, fur traders, and patrols of the old North-West Mounted Police.

The sparkling lakes of the Qu'Appelle Valley have popular summer resorts that feature boating, fishing, golfing, and swimming. Northern Saskatchewan offers some of the best hunting and fishing in North America. Sportsmen fly there to fish for grayling and trout, or to hunt bears and moose. The southern plains attract many duck hunters.

PLACES TO VISIT

Following are brief descriptions of some of Saskatchewan's many interesting places to visit.

Fort Walsh, in the Cypress Hills, is a reconstruction of a North-West Mounted Police fort built in 1875. The fort, surrounded by a high stockade, includes a number of historical exhibits.

Moose Jaw Wild Animal Park is the largest of its kind in Saskatchewan. It has lions, monkeys, and many animals that live in the province.

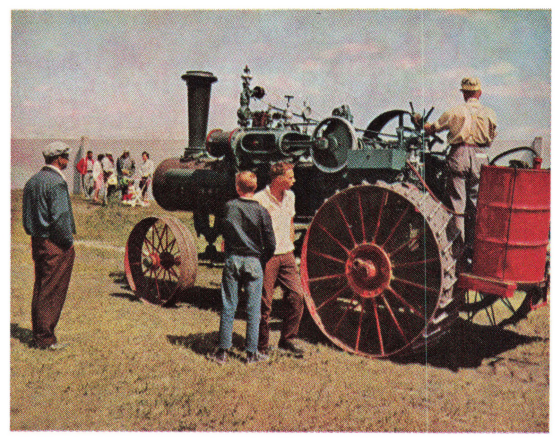
Royal Canadian Mounted Police Training Center, in Regina, is the Mounties' training headquarters. The center has a museum containing historic documents, uniforms, and weapons.

Western Development Museum, in Saskatoon, has a collection of antique cars, pioneer household equipment, and steam engines.

National Parks and Sites. Prince Albert National Park lies in central Saskatchewan, north of Prince Albert. The province also has three national historic parks and sites—Batoche, Battleford, and Fort Walsh. For the area and chief features of these parks and sites, see CANADA (National Park System).

Provincial Parks. Saskatchewan has 17 provincial parks and 85 regional parks in the southern and central parts of the province. For information on Saskatchewan's parks, write to the Department of Tourism and Renewable Resources, Regina, Sask.

Western Development Museum in Saskatoon



Provincial Government of Saskatchewan

Boating in Prince Albert National Park

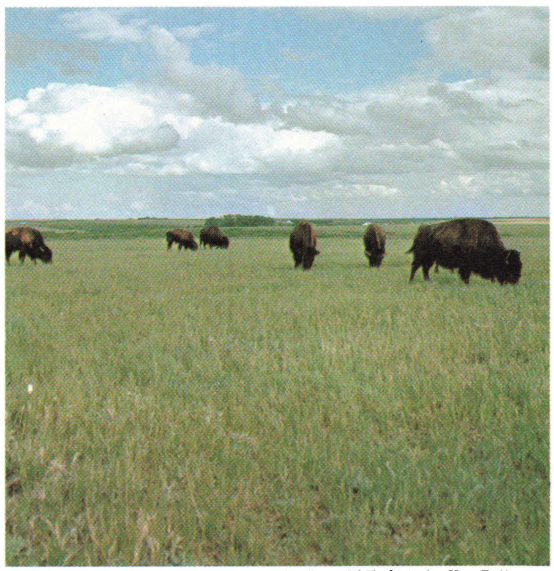
ANNUAL EVENTS

Popular outdoor events in Saskatchewan include the opening of the fishing season during the early part of May in the southern area and later in the month in the north. Many cities and towns hold three-day agricultural and industrial fairs in July and August. Other annual events include the following.

January-May: Prince Albert Winter Festival (February); Kinsmen International Band Festival in Moose Jaw (late May).

June-August: Dominion Day, province-wide (July 1); Frontier Days Rodeo in Swift Current (July); Saskachimo in Saskatoon (July); Territorial Days Celebration in North Battleford (July); Buffalo Days in Regina (late July and early August).

September-December: Western Canadian Amateur Champion Fiddling Contest in Swift Current (October); Knights of Columbus Saskatchewan Indoor Games in Saskatoon (December); Snowmobile Races in Kenaston (December).



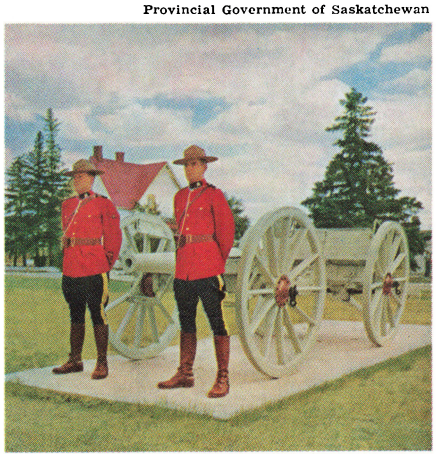
WORLD BOOK photo by Ken Patterson

Province of Saskatchewan

Buffalo Roam Grasslands and Visitors Watch a Lion at Moose Jaw Wild Animal Park.

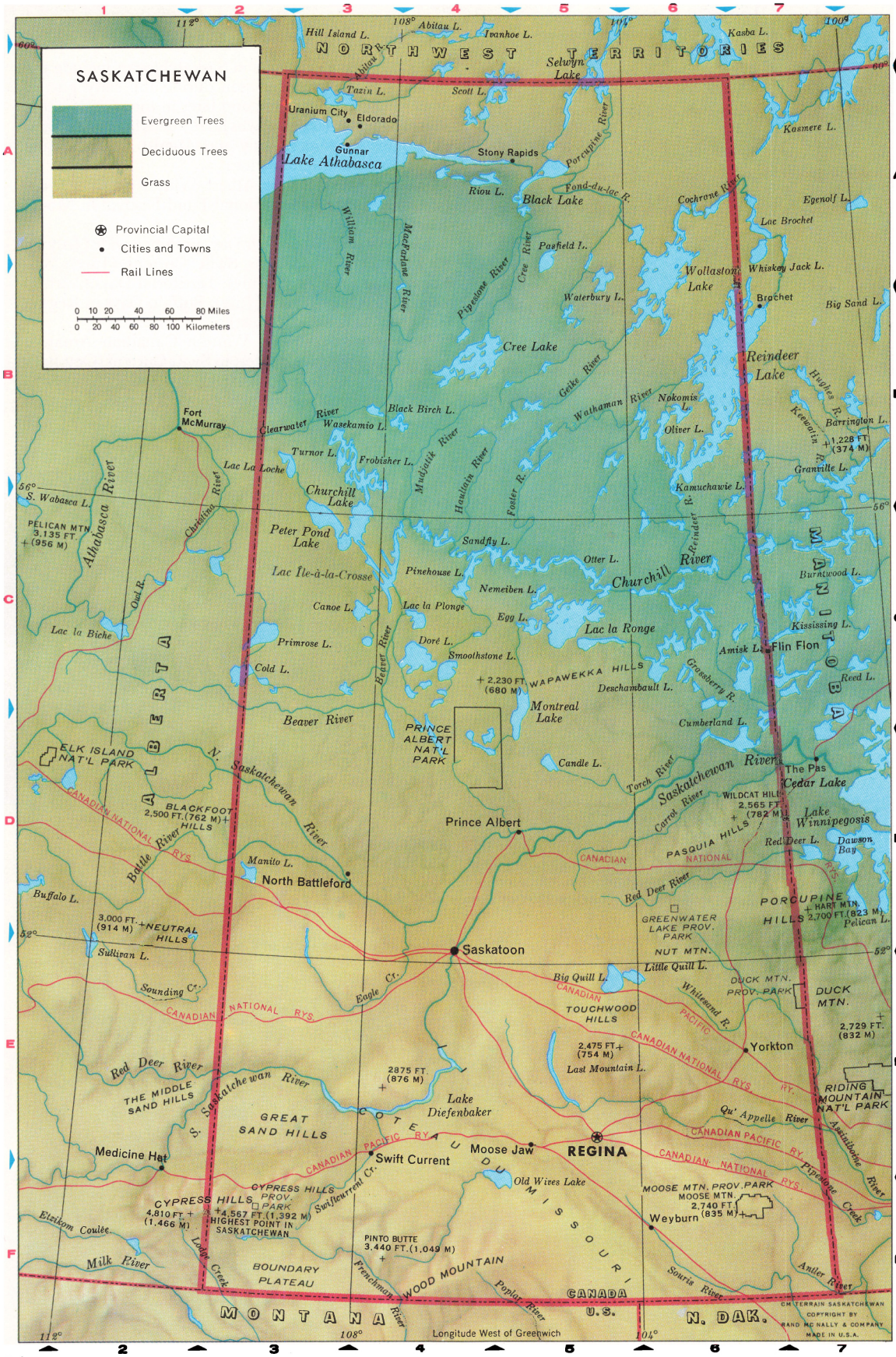
Battleford National Historic Park

Provincial Government of Saskatchewan



Duck Hunting on a Saskatchewan Pond

Provincial Government of Saskatchewan



Specially created for **World Book Encyclopedia** by Rand McNally and World Book editors

Land Regions. Saskatchewan has four land regions: (1) the Canadian Shield, (2) the Manitoba Lowland, (3) the Saskatchewan Plain, and (4) the Alberta Plain. The lowland and plain regions form part of the Western Interior Plains, the Canadian section of the North American Great Plains.

The Canadian Shield is a vast, horseshoe-shaped region that covers almost half of Canada and dips into the United States. This rough area, made up of ancient granites and other rocks, covers most of the northern half of Saskatchewan. It has deposits of copper, uranium, zinc, and many other minerals. The region also has the largest lakes of the province. Pine and spruce forests cover most of the land. An area of *muskegs* (peat bogs) is in the northeast. See CANADIAN SHIELD.

The Manitoba Lowland extends westward from the Manitoba border for about 90 miles (140 kilometers). Rocky soils and poor drainage make the land generally unsuitable for farming. The region has large areas of marshes and forests, and many lakes and rivers.

The Saskatchewan Plain is mostly level land, broken by some low hills. Most of the region is from 1,700 to 2,000 feet (518 to 610 meters) above sea level. Commercial forests grow in the northern part of the plain. To the south are grasslands with scattered groves of trees that give way to almost treeless plains. Saskatchewan's chief farming area lies in this region.

The Alberta Plain is separated from the Saskatchewan Plain by a hilly belt called the *Missouri Coteau* or *Missouri Escarpment*. Most of the region is rolling, treeless land, 2,000 to 3,000 feet (610 to 910 meters) high, with deep river valleys. The highest hill in the province rises

Land Regions of Saskatchewan

Dean, Miller Services

The Qu'Appelle River winds through southeastern Saskatchewan into Manitoba. This river helps drain the southern part of the province. The river valley has some of Saskatchewan's best farmland.

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Provincial Government of Saskatchewan

Peat Bogs called *muskegs* lie in the far northeastern section of the Canadian Shield. Pine and spruce forests cover most of the shield. The shield has the largest lakes in Saskatchewan.

to 4,567 feet (1,392 meters) in the Cypress Hills, a wooded plateau in the southwest. The region's northern strip extends into the commercial forest belt.

Rivers and Lakes. Southern Saskatchewan, which has a dry climate, has few important rivers and lakes. The most important river is the Saskatchewan River, 1,205 miles (1,939 kilometers) long. It is fed by waters from Alberta and Montana. Its major branches in the province are the North Saskatchewan and South Saskatchewan rivers. The Assiniboine River and its main branches, the Qu'Appelle and Souris, drain southeastern Saskatchewan. The largest lakes in the south are Old Wives and Quill lakes, which are shallow and salty, and Last Mountain Lake. Gardiner Dam, built on the South Saskatchewan River near Outlook, created a 170-square-mile (440-square-kilometer) reservoir called Lake Diefenbaker. It provides water to irrigate 500,000 acres (200,000 hectares) of farmland.

Northern Saskatchewan is less dry, and has most of the rivers and lakes. The Churchill River system and the rivers flowing into Lake Athabasca drain northern Saskatchewan. Many northern rivers are actually narrow lakes that connect with each other. Lake Athabasca, the largest of Saskatchewan's many lakes, covers 3,120 square miles (8,081 square kilometers). About a third of it extends into Alberta. Other large lakes include Reindeer, Wollaston, La Ronge, and Cree lakes.

Forests and Farms surround Batoche Rectory near Duck Lake in the Saskatchewan Plain. The province's most important commercial forests are in the northern part of this region. Almost treeless grasslands in the south provide an excellent farming area.

C.O. Dean, Miller Services

SASKATCHEWAN / *Climate*

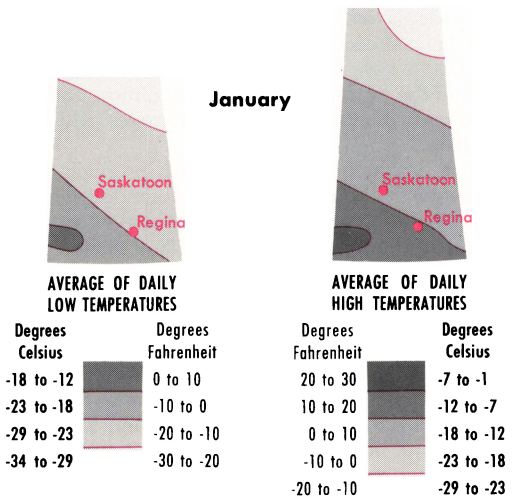
Saskatchewan has short, warm summers and cold winters. Average January temperatures range from −23° F. (−31° C) in the northeast to 10° F. (−12° C) in the southwest. Warm chinook winds may raise winter temperatures as much as 20 degrees Fahrenheit (11 degrees Celsius) within a few hours (see CHINOOK). Average July temperatures vary between 57° F. (14° C) in the northeast and 67° F. (19° C) in the southwest. The lowest temperature recorded, −70° F. (−57° C), occurred in Prince Albert on Feb. 1, 1893. Midale and Yellow Grass had the highest temperature, 113° F. (45° C), on July 5, 1937.

Saskatchewan's annual *precipitation* (rain, melted snow, and other forms of moisture) ranges from 12 to 17 inches (30 to 43 centimeters). Annual snowfall varies from 50 inches (130 centimeters) in the north to 30 inches (76 centimeters) in the south.

Murray, Miller Services

Winter Comes Early in Saskatchewan. Freezing temperatures cause ice even on the largest river, the Saskatchewan.

SEASONAL TEMPERATURES



AVERAGE OF DAILY LOW TEMPERATURES

Degrees Celsius	Degrees Fahrenheit
-18 to -12	0 to 10
-23 to -18	-10 to 0
-29 to -23	-20 to -10
-34 to -29	-30 to -20

AVERAGE OF DAILY HIGH TEMPERATURES

Degrees Fahrenheit	Degrees Celsius
20 to 30	-7 to -1
10 to 20	-12 to -7
0 to 10	-18 to -12
-10 to 0	-23 to -18
-20 to -10	-29 to -23

AVERAGE OF DAILY LOW TEMPERATURES

Degrees Celsius	Degrees Fahrenheit
10 to 13	50 to 55
7 to 10	45 to 50

AVERAGE OF DAILY HIGH TEMPERATURES

Degrees Fahrenheit	Degrees Celsius
80 to 85	27 to 29
75 to 80	24 to 27
70 to 75	21 to 24
65 to 70	18 to 21

AVERAGE YEARLY PRECIPITATION
(Rain, Melted Snow and Other Moisture)

Centimeters	Inches
38 to 51	15 to 20
25 to 38	10 to 15

0 200 400 Miles
0 300 600 Kilometers

WORLD BOOK maps

AVERAGE MONTHLY WEATHER

	REGINA Temperatures F° High	Low	C° High	Low	Days of Rain or Snow		SASKATOON Temperatures F° High	Low	C° High	Low	Days of Rain or Snow
JAN.	12	-7	-11	-22	11	JAN.	10	-8	-12	-22	9
FEB.	16	-5	-9	-21	10	FEB.	14	-5	-10	-21	9
MAR.	29	9	-2	-13	10	MAR.	28	10	-2	-12	7
APR.	50	27	10	-3	8	APR.	49	28	9	-2	7
MAY	66	38	19	3	8	MAY	65	39	18	4	9
JUNE	73	47	23	8	13	JUNE	72	48	22	9	12
JULY	81	52	27	11	10	JULY	79	54	26	12	10
AUG.	78	49	26	9	9	AUG.	76	50	24	10	9
SEPT.	67	39	19	4	7	SEPT.	65	40	18	4	8
OCT.	53	29	12	-2	6	OCT.	51	30	11	-1	7
NOV.	31	13	-1	-11	10	NOV.	29	13	-2	-11	9
DEC.	18	0	-8	-18	11	DEC.	15	0	-9	-18	9

In early days, the economy of the Saskatchewan region was based on the fur trade. Wheat growing and ranching became important during the late 1800's. Today, farming is the chief source of income. Saskatchewan grows more wheat than any other province or state.

All values given in this section are in Canadian dollars. For the value of Canadian dollars in U.S. money, see MONEY (table).

Natural Resources of Saskatchewan include fertile soils and valuable minerals and forests.

Soil. The rich grassland soils of southern Saskatchewan are probably the province's chief natural resource. These soils lie in parallel zones that slant from northwest to southeast. The far southwestern zone has brown soils that produce good crops when enough rain falls. But the region is dry, and much of it is used for raising cattle. Rainfall increases to the northeast, where dark brown and black soils are found. These soils are the most fertile in the province. The northern forest region has less fertile, gray soils.

Minerals. The Canadian Shield has varied mineral deposits, including copper, gold, silver, uranium, and zinc. The most important deposits are near Amisk, Athabasca, La Ronge, and Wollaston lakes. Deposits of iron ore lie near Choiceland. Salt and potash occur in a wide belt in south-central Saskatchewan. The potash deposits are the largest in the world.

Southern Saskatchewan has about 600 million barrels of proved petroleum deposits. This area also has large deposits of salt, coal, and natural gas. About 200 million short tons (180 million metric tons) of sodium sulfate occur in the southern lake beds. The deposits of this salt, used in medicine and manufacturing, are among the richest in the world. Helium is found at Wood Mountain and near Swift Current. Many areas of the province have clay, gravel, and sand.

Forests cover about 50,000 square miles (129,000 square kilometers) in Saskatchewan, or about a fourth of the land area of the province. Commercial forests cover about 47,000 square miles (122,000 square kilometers). These forests extend across the province in an irregular belt about 150 miles (241 kilometers) wide, most of it north of Prince Albert. The most valuable trees in this belt are birch, jack pine, poplar, and spruce. Other trees of Saskatchewan include balsam fir and larch.

Plant Life. The provincial flower, the prairie lily, grows throughout the plains regions, as do cacti, crocuses, vetches, and violets. Shrubs such as chokecherries, hazels, and wild roses grow in the woodlands.

Animal Life. Elk, moose, and Barren Ground caribou live mainly in woodlands of the central and northern regions. Deer and rabbits may be seen throughout the province. Fur-bearing animals in the forests include bears, beavers, minks, otters, and wolves. Pronghorn antelopes and coyotes roam the southwestern plains.

Game birds, especially ducks and geese, nest along the lakes. Partridges, pheasants, and ruffed and sharp-tailed grouse live in the southern Saskatchewan Plain. The lakes and rivers have pickerel, pike, trout, tullibee, and whitefish. Grayling live chiefly in the northern waters.

Agriculture. Saskatchewan's farm products provide an annual income of about $\$1\frac{1}{4}$ billion. Saskatchewan has about 65,057,000 acres (26,327,600 hectares) of farmland—more than any other province, and over a third of Canada's total. Much of the land is unused each year. This helps the soil store moisture. The province has about 77,000 farms. They cover most of the land west and south of the Manitoba Lowland, or almost half the total land area. The farms average 845 acres (342 hectares) in size.

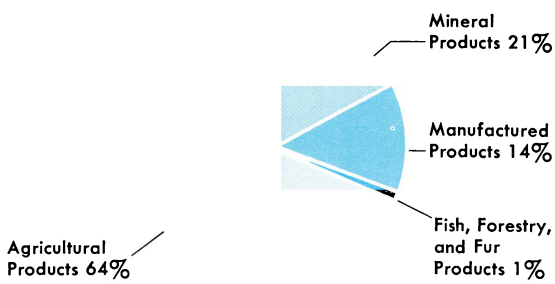
Wheat is Saskatchewan's chief farm product. Saskatchewan raises about two-thirds of Canada's wheat, or about 395 million bushels (10,665,000,000 kilograms) yearly. About 16 million acres (6.5 million hectares) of land are devoted to wheat.

The raising of beef cattle is Saskatchewan's second-ranking agricultural activity. Saskatchewan has about $2\frac{1}{2}$ million beef cattle. Its 96,000 dairy cattle produce about 650 million pounds (295 million kilograms) of milk each year. The largest cattle-raising areas are near Lloydminster, Moosomin, Swift Current, and Yorkton. Hogs are also an important source of farm income.

Saskatchewan ranks second only to Alberta in the production of barley among the provinces of Canada and states of the United States. It also ranks among the top producers of hay and oats. Farmers also raise large crops of flaxseed, rapeseed, and rye. Other farm

PRODUCTION OF GOODS IN SASKATCHEWAN

Total value of goods produced in 1972—$1,879,952,000



Percentages are based on farm cash receipts, value added by forestry and manufacture, and value of fishing, fur, and mineral production.
Sources: Canadian government publications, 1974.

EMPLOYMENT IN SASKATCHEWAN

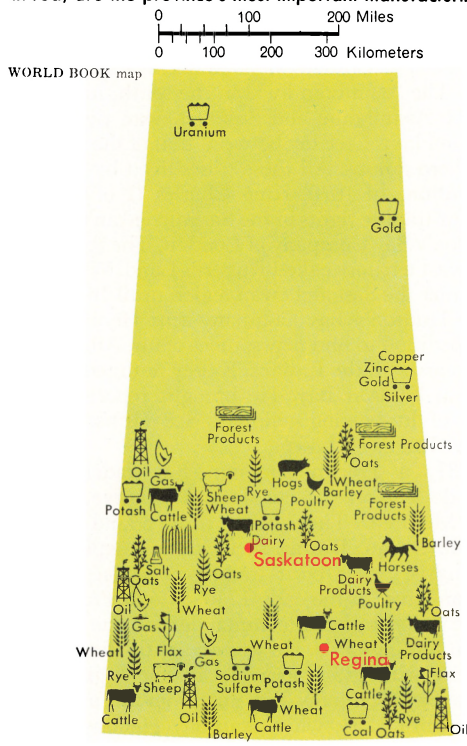
Total number of persons employed in 1972—280,600

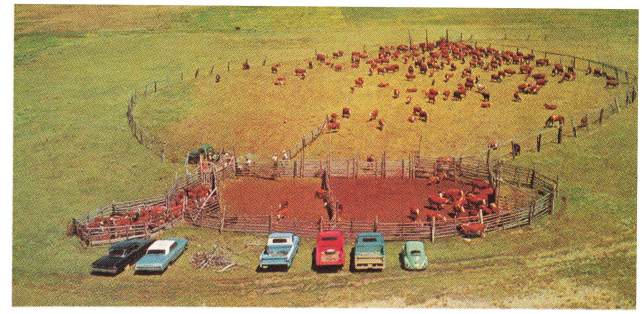
	Number of Employees
Agriculture	86,500*
Community, Business, & Personal Services	73,900
Wholesale & Retail Trade	41,200
Transportation, Communication, & Utilities	26,600
Government	19,700
Manufacturing	17,000
Finance, Insurance, & Real Estate	8,600
Mining	5,300
Fishing	1,800

*1973 figure.
Sources: *Estimates of Employees by Province and Industry, 1961-1972,* March, 1974, Statistics Canada; *Fisheries Statistics of Canada, 1972,* May, 1974, Statistics Canada; Labor Division, Statistics Canada.

FARM, MINERAL, AND FOREST PRODUCTS

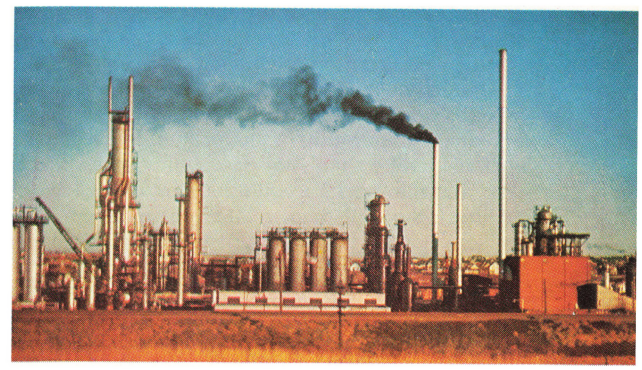
This map shows where the province's leading farm, mineral, and forest products are produced. The major urban areas (shown in red) are the province's most important manufacturing centers.





Dean, Miller Services

Cattle Await Branding in the Big Muddy Valley. The raising of beef cattle is Saskatchewan's second-ranking farm activity. The province has about two-fifths of Canada's farmland.



Dobyn, Shostal

Oil Refinery spreads across the prairie near Moose Jaw. Saskatchewan provides about an eighth of Canada's petroleum. The province also produces much potash, sodium sulfate, and uranium.

products in Saskatchewan include honey and poultry.

Mining is the fastest-growing industry in Saskatchewan. The province's mineral products have an annual value of about $406 million. Saskatchewan is a leader among the provinces and states in the production of gold, petroleum, potash, and uranium.

Petroleum is the major mineral product of Saskatchewan. Oil wells in the province pump about 85 million barrels of petroleum a year. Saskatchewan produces about an eighth of Canada's petroleum. Most wells are in the southeast, between Gainsborough and Weyburn. They produce light and medium crude oil.

Potash mining has developed rapidly and is Saskatchewan's second-ranking mining industry. About 3,852,000 short tons (3,494,000 metric tons) of potash are mined each year. Major potash mines, completed during the early and middle 1960's, operate near Allan, Belle Plaine, Colonsay, Esterhazy, Lanigan, Rocanville, and Saskatoon. Most of the potash is used in fertilizers.

Copper mining is the province's third-ranking mining industry. The annual copper output is about 13,000 short tons (11,800 metric tons). The ore comes chiefly from the Flin Flon Mine on the Saskatchewan-Manitoba border. Annual coal production totals about 3 million short tons (2.7 million metric tons), about a fifth of Canada's total. Strip mines near Estevan supply all of the coal, which is of the lignite type.

Uranium mining became important after the discovery of deposits in 1950. The uranium ore comes from the Uranium City area in the far northwest and from the Wollaston Lake area in northeast Saskatchewan. Saskatchewan produces about 15 per cent of Canada's uranium.

Saskatchewan produces almost all of Canada's sodium sulfate. Much of it comes from the Chaplin Lake area. Natural gas fields, chiefly in western Saskatchewan, yield about 69 billion cubic feet (1.9 billion cubic meters) of gas a year. Pipelines carry the gas to cities and industrial centers. In 1957, Regina became the first city to receive natural gas through the Trans-Canada Pipeline. Other important minerals produced include gold, helium, nitrogen, salt, sand and gravel, silver, sulfur, and zinc.

Manufacturing. Goods manufactured in Saskatchewan have a *value added by manufacture* of about $257 million yearly. This figure represents the value created in products by Saskatchewan's industries, not counting such costs as materials, supplies, and fuels.

Food processing is Saskatchewan's chief manufacturing activity. It has an annual value added by manufacture of about $91 million. Many cities, including Prince Albert, Regina, and Saskatoon, have slaughtering and meat-packing plants. Saskatoon and Swift Current have flour mills. Dairy-product centers include Moose Jaw, Prince Albert, Regina, and Saskatoon.

The production of lumber and wood products is Saskatchewan's second-ranking manufacturing activity. These products have a value added by manufacture of about $25 million. The province's centers for lumber and wood production include the Hudson Bay, Meadow Lake, and Prince Albert areas, and parts of northern Saskatchewan.

Other important manufacturing activities in Saskatchewan include the production of petroleum and coal products and printed materials. The manufacture of chemicals, fabricated metal products, and machinery are also important activities.

Forestry. Forestry products in Saskatchewan have an annual value of about $7,690,000. Lumbermen in the commercial forest zone cut about 140 million board feet (330,000 cubic meters) of lumber yearly. The poplar forests in the north-central section supply the most timber. Products include fuelwood, logs and bolts, and pulpwood. Prince Albert is the chief center of the forest industry. The province's first pulp mill, one of the largest in the world, started production there in 1968.

Fur Industry. Animal pelts provide an annual income of about $4,309,000. Animals caught by trappers account for about four-fifths of this income. The rest comes from the fur of animals raised on fur farms. Beaver, coyote, and mink pelts account for most of the income.

Fishing Industry. Commercial fishing produces about 11 million pounds (4,990,000 kilograms) of fish a year. The annual fish catch is valued at $1,634,000. Lakes that supply most of the catch are, in order of yield, Athabasca, Reindeer, Dore, Last Mountain, and Wollaston. Whitefish account for about half the catch, pickerel for about a third, and trout for an eighth. Plants in the north freeze some fish for shipment, but much fresh fish is shipped by air.

Electric Power. Since 1949, the government-owned Saskatchewan Power Corporation has supplied most of the province's electric power. About three-fourths of the power comes from steam plants. The rest comes from hydroelectric plants.

Transportation. Saskatchewan has about 130,000 miles (209,000 kilometers) of roads, or about a fourth of Canada's road mileage. The roads and highways stretch mainly over the southern half of the province, where most of the people live. In 1957, Saskatchewan became the first province to complete its portion of the Trans-Canada Highway, which runs from St. John's, Nfld., to Victoria, B.C.

The province has more than 10 major airports. Three commercial airlines serve the southern cities. Various flights link the scattered settlements of the north and the southern cities. Saskatchewan has about 8,600 miles (13,800 kilometers) of railways, all in the south. Important terminals operate in Melfort, Moose Jaw, Regina, Saskatoon, and Weyburn.

Communication. The first newspaper in the Saskatchewan region was the *Saskatchewan Herald*, established in Battleford in 1878. Today, Saskatchewan has four daily newspapers. They are, in order of size, *The Leader-Post* of Regina, *The* (Saskatoon) *Star-Phoenix*, *The Moose Jaw Times-Herald*, and the *Prince Albert Daily Herald*. About 100 weekly newspapers are published in the province.

Radio broadcasting in Saskatchewan began in 1922 when stations CHAB in Moose Jaw and CKCK in Regina went on the air. The province's first television stations, CKCK in Regina and CFQC in Saskatoon, began broadcasting in 1954. The province now has over 20 radio stations and 7 major television stations.

Indian Days. The first white men in the Saskatchewan region found three Indian tribes roaming the forests and prairies. The Chipewyan lived north of the Churchill River. The Assiniboin lived in the south, in the valleys of the Assiniboine and Saskatchewan rivers. The land of the Plains Cree lay between that of the northern and southern groups. All these tribes lived by hunting.

Exploration. In 1670, King Charles II of England granted fur-trading rights in the Saskatchewan region to the Hudson's Bay Company of London. The region was part of a vast territory called Rupert's Land. White men did not enter the Saskatchewan region until 1690. That year, the Hudson's Bay Company sent Henry Kelsey on an expedition to find new sources of fur. After spending two years with the Indians, Kelsey returned to York Factory on Hudson Bay. He brought reports of vast numbers of fur-bearing animals. See HUDSON'S BAY COMPANY; RUPERT'S LAND.

In 1731, a French-Canadian fur trader, Pierre Gaultier de Varennes, Sieur de la Vérendrye, and his sons left Montreal. They sought an overland route to the Pacific Ocean. During their western explorations, La Vérendrye's sons built trading posts on the Saskatchewan River in the early 1740's. Louis François de la Corne later became commander of the French-Canadian trading posts. He was one of the first men to experiment with grain growing in the region. The Hudson's Bay Company did not promote further exploration until 1754, when Anthony Henday crossed the region on his way to the Rocky Mountain foothills.

Fur-Trading Settlements. In 1774, Samuel Hearne of

IMPORTANT DATES IN SASKATCHEWAN

1670 King Charles II of England granted trading rights in the Saskatchewan region to the Hudson's Bay Company.

1690-1692 Henry Kelsey of the Hudson's Bay Company explored the Saskatchewan region.

1740's The La Vérendrye brothers, French-Canadian fur traders, built trading posts on the Saskatchewan River.

1774 Cumberland House, Saskatchewan's first permanent settlement, was established.

1870 Canada acquired Rupert's Land and made it part of the North West Territories.

1882-1883 The Canadian Pacific Railway was built across the Saskatchewan region.

1885 The métis rebelled against the Canadian government in the Saskatchewan Rebellion.

1905 Saskatchewan became a province on September 1.

1924 Farmers organized the Saskatchewan Wheat Pool.

1944 The voters of Saskatchewan elected the first socialist government in Canada.

1947 Saskatchewan became the first province to provide all residents with free hospital care financed by taxes.

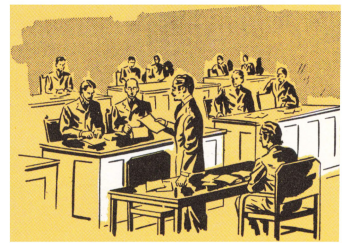
1951-1952 Major deposits of petroleum were discovered in Saskatchewan.

1962 Continuous potash production started in Saskatchewan. The province began a program of tax-supported, free medical care for all residents. In protest, doctors treated only emergency cases for 23 days.

1964 The Liberals defeated the socialist government.

1971 The New Democratic Party won power in the provincial legislature and formed another socialist government.

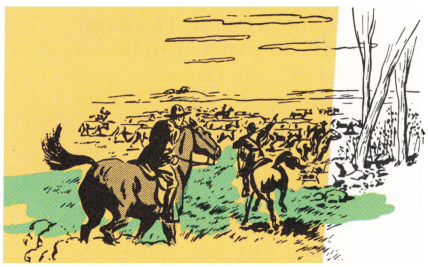
Henry Kelsey in 1690 became the first white man to enter the Saskatchewan region. He lived with the Indians for two years.



Saskatchewan Became a Province within the Dominion of Canada in 1905, upon passage of a bill in Parliament.

HISTORIC SASKATCHEWAN

Free Homesteads and rising wheat prices attracted thousands of settlers to Saskatchewan after 1900.

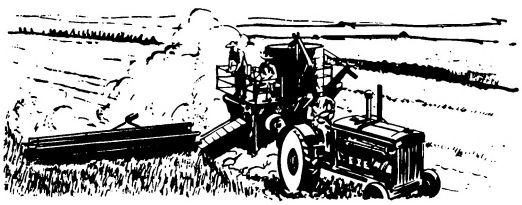


The North-West Mounted Police provided law and order on the rough Saskatchewan frontier starting in 1874.

• Prince Albert

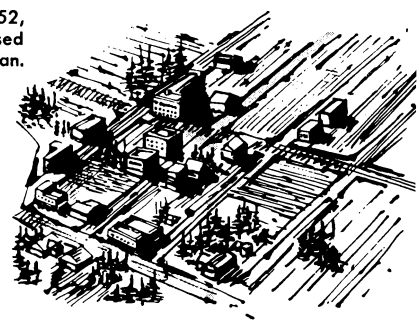
Louis Riel led a métis rebellion against the Canadian government in 1885. The uprising was crushed that same year.

• Saskatoon



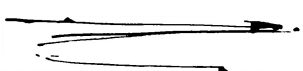
Waving Fields of Grain cover more land than any other farm crop, making Saskatchewan "Canada's Breadbasket."

Uranium City was established in 1952, after the discovery of uranium caused a rush to northwestern Saskatchewan.



REGINA ★

Cumberland House, the first permanent settlement in Saskatchewan, was established at Cumberland Lake in 1774.



Ernest Brown Collection, Province of Alberta

Cree Indians joined the famous 1885 rebellion led by Louis Riel against the Canadian government. This picture was taken inside Fort Pitt in western Saskatchewan. A few months later, the Cree chiefs shown here led Indians in looting and burning the fort.

the Hudson's Bay Company built Cumberland House on Cumberland Lake. This trading post was the company's first in the interior of Rupert's Land. The post became the first permanent settlement in the Saskatchewan region. During the following years, other trading posts were established, most of them in the north. During the late 1770's, fur traders in Montreal formed the North West Company to compete with the Hudson's Bay Company. The two fur-trading firms operated in the Saskatchewan region until 1821, when the North West Company combined with the Hudson's Bay Company. See NORTH WEST COMPANY.

North West Territories. In 1870, the newly formed Dominion of Canada acquired Rupert's Land from the Hudson's Bay Company. Canada paid the company $1,500,000 and permitted it to keep large areas of the plains. Later in 1870, Canada established the North West Territories, which included the former Rupert's Land. At first, the lieutenant governor of Manitoba governed the Territories. But in 1875, the Canadian parliament passed an act that reorganized the territorial government. The Canadian government appointed a territorial lieutenant governor and council, and provided for elected members to be added gradually to the council. In 1876, the first lieutenant governor, David Laird, took office. The council met in Fort Livingstone, near what is now Pelly, in 1877. The government moved to Battleford the next year.

In 1882, the Canadian government divided part of the Territories into districts. Two of these districts, Assiniboia and Saskatchewan, made up most of what is now Saskatchewan. Regina became the territorial capital in 1883.

Métis and Indian Troubles. The Canadian Pacific Railway was built across the Saskatchewan region in 1882 and 1883. The railroad opened the region to agricultural settlement, and led to the establishment of many towns. *Métis* (persons of mixed Indian and white descent) and Indians feared the settlers would destroy the buffalo herds. These people depended on the buffalo for food and clothing. The métis had no legal titles to their lands, and thought they would lose their homes to the white settlers. In 1885, the métis and some Indians, led by Louis Riel, joined in the Saskatchewan Rebellion against the Canadian government. See RIEL, LOUIS; SASKATCHEWAN REBELLION.

Territorial Progress. Agricultural settlement spread slowly during the late 1800's. The raising of wheat near the Canadian Pacific Railway began on a large scale during the 1880's. Ranching became important in the 1890's. Most of the early settlers came from Ontario. They established churches, newspapers, and schools, and asked for a more democratic form of government. In 1888, the settlers gained the right to elect a legislative assembly for the North West Territories.

Settlement was rapid after 1900. Good free land and rising wheat prices attracted thousands of immigrants from Europe and the United States. The larger population required a more efficient government than a territorial administration. In 1905, the Canadian government created the province of Saskatchewan. Walter Scott, a Liberal, became the first premier.

The Early 1900's. The Saskatchewan legislature met for the first time in 1906, in Regina. Settlement spread rapidly, railway construction expanded, and cities grew into important trading and supply centers.

During World War I (1914-1918), the province's farmers provided Great Britain and its allies with great amounts of food. Farm production continued to increase after the war. But world wheat prices fell, and a better method of the marketing of grain was needed. This need gave birth in 1924 to the Saskatchewan Wheat Pool, which became a huge farmers' cooperative.

Between World Wars. The depression caused by the fall of wheat prices ended after a few years, and Saskatchewan's farmers prospered again. In 1930, the provincial government took control of Saskatchewan's natural resources, including forests and mineral deposits. These resources had been controlled by the federal government since territorial days.

The world-wide depression of the 1930's hit Saskatchewan hard, and farm prices dropped again. Drought, soil drifting, and grasshoppers destroyed crops. The Wheat Pool nearly collapsed early in this period. Thousands of people left Saskatchewan to seek work elsewhere in Canada. The federal government provided some emergency financial aid. After 1935, work programs and land improvement projects of the federal Prairie Farm Rehabilitation Administration also helped (see PRAIRIE FARM REHABILITATION ACT).

Late in June, 1935, a trainload of unemployed workers arrived in Regina from British Columbia, which was also suffering from the depression. They had been going to Ottawa to complain to the federal government about their living conditions, but federal officials ordered them to stop. The workers resented this order. On July 1, a fight called the Regina Riot occurred between the police and some of the workers. Many on both sides

THE PREMIERS OF SASKATCHEWAN

	Party	Term
1. Walter Scott	Liberal	1905-1916
2. William M. Martin	Liberal	1916-1922
3. Charles A. Dunning	Liberal	1922-1926
4. James G. Gardiner	Liberal	1926-1929
5. James T. M. Anderson	Conservative	1929-1934
6. James G. Gardiner	Liberal	1934-1935
7. William J. Patterson	Liberal	1935-1944
8. Thomas C. Douglas	Co-operative Commonwealth Federation	1944-1961
9. Woodrow S. Lloyd	Co-operative Commonwealth Federation	1961-1964
10. W. Ross Thatcher	Liberal	1964-1971
11. Allan E. Blakeney	New Democratic	1971-

were injured, and the rioters killed one policeman. The workers returned to their homes a few days later.

The Mid-1900's brought great political, economic, and social changes to the province. Since 1905, Saskatchewan voters had elected Liberal Party governments in every election except one. But in 1944, the voters elected a socialist government headed by Thomas C. Douglas of the Co-operative Commonwealth Federation (C.C.F.). The C.C.F. was the first socialist government ever elected to office in Canada. It controlled the provincial government from 1944 to 1964, when the Liberals were re-elected.

The C.C.F. pioneered in health programs that became models for similar plans throughout Canada. In 1947, Saskatchewan became the first province to provide hospital care for all its people. In 1962, it became the first province to furnish medical care for all residents. Many people, especially physicians, opposed the 1962 plan at first. In 1962, in protest against the plan, doctors treated only emergency cases for 23 days. But the plan later was accepted throughout Saskatchewan. In 1967, it became part of a larger program established by the Canadian government for all Canadians.

During the first years of the C.C.F. administration, the provincial government experimented with state-owned companies called *crown corporations*. Many of these corporations failed. As a result, the government changed to a policy of encouraging industrial growth by welcoming private investment and by lending money to private industries. Two crown corporations—an electric power and natural gas utility and an insurance company—succeeded and are still in operation.

Industrial development started later in Saskatchewan than in most other parts of Canada. Rapid industrialization began in the early 1950's, and much of it was related to mineral discoveries. Major deposits of petroleum were discovered in 1951 and 1952. In the early 1970's, Saskatchewan was producing about a fifth of Canada's oil, or about 88 million barrels a year. The provincial government established Uranium City in northwestern Saskatchewan in 1952 following the discovery of uranium in that area. Potash beds of unusual purity and quantity were discovered at about the same time. Continuous potash production began in 1962.

Along with increased industrialization, major changes took place in Saskatchewan's agricultural economy. In the mid-1900's, farmers stepped up their use of machinery. The increased use of machinery, along with improved farming methods, enabled the farmers to produce more with a smaller number of workers. By the late 1960's, Saskatchewan had fewer but larger farms as many small family farms were replaced by larger farms.

In 1946, about three-fourths of Saskatchewan's people lived in rural areas. Because of the industrial development and agricultural changes, many farmworkers took jobs in the petroleum and potash industries or in related industries. By 1969, about half the people lived in cities or towns.

Saskatchewan Today. Agriculture will probably continue to be the province's largest source of income during the 1970's. Saskatchewan farmers harvested an almost unbroken series of huge wheat crops in the 1960's. At the same time, world markets for wheat decreased, resulting in a huge build-up of wheat supplies. By 1970, the farmers had about 1 billion bushels (27 billion kilograms) of wheat on hand, enough to meet export needs for three years. To avoid the risks of a one-crop industry, many Saskatchewan farmers added the raising of livestock and poultry to their activities. In 1969, to help ease the wheat surplus problem, the provincial government began trading Saskatchewan wheat to other countries in exchange for machinery.

The wheat surplus problem also affected other areas of Saskatchewan's economy. Farmers were short of money to pay for goods and services. As a result, many people who provided goods and services—including salesmen and mechanics—left the province to find better opportunities. By 1970, about 1,000 persons a month were leaving Saskatchewan.

Saskatchewan's uranium industry grew rapidly in the early 1950's because of high world demand. The industry slumped about 1958, but renewed world interest in the early 1970's encouraged further development.

Potash mining is the fastest-growing mining industry in Saskatchewan. Several companies are producing potash for use mainly as fertilizer. Because of the increasing world demand, the province expects the value of its potash exports to equal that of its wheat exports by the late 1970's.

Saskatchewan voters elected a socialist government again in 1971. They gave control of the legislature to the New Democratic Party. The Cooperative Commonwealth Federation had officially changed its name to the New Democratic Party in 1968.

STIRLING KING and J. HOWARD RICHARDS

SASKATCHEWAN / *Study Aids*

Related Articles in WORLD BOOK include:

CITIES AND TOWNS

Battleford, Moose Jaw, Prince Albert, Regina, Saskatoon, Uranium City

HISTORY

Canada, History of; Hudson's Bay Company; North West Company; Rupert's Land; Saskatchewan Rebellion

PHYSICAL FEATURES

Assiniboine River, Churchill River, Lake Athabasca, Reindeer Lake, Saskatchewan River, Wollaston Lake

SASKATCHEWAN

PRODUCTS

For Saskatchewan's rank among the provinces and states in production, see the following articles:

Barley, Oats, Rye, Wheat, Flax, Petroleum, Uranium

OTHER RELATED ARTICLES

Canadian Shield
Saskatchewan, University of
McNaughton, Andrew G. L.

Outline

I. Government
- A. Lieutenant Governor
- B. Premier
- C. Legislative Assembly
- D. Courts
- E. Local Government
- F. Taxation
- G. Politics

II. People

III. Education
- A. Schools
- B. Libraries
- C. Museums

IV. A Visitor's Guide
- A. Places to Visit
- B. Annual Events

V. The Land
- A. Land Regions
- B. Rivers and Lakes

VI. Climate

VII. Economy
- A. Natural Resources
- B. Agriculture
- C. Mining
- D. Manufacturing
- E. Forestry
- F. Fur Industry
- G. Fishing Industry
- H. Electric Power
- I. Transportation
- J. Communication

VIII. History

Questions

What is the chief farm product of Saskatchewan?

How did Saskatchewan pioneer in public health plans?

In which two cities do over a fourth of the people of Saskatchewan live?

What is the fastest-growing mining industry in Saskatchewan?

Where is Saskatchewan's chief farming region?

What is the Saskatchewan Wheat Pool?

Why did the métis of Saskatchewan rebel in 1885?

What is Saskatchewan's major manufacturing activity?

Which part of the province has the most rivers and lakes? Why?

How does local government in southern and northern Saskatchewan differ?

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WIEBE, RUDY. *The Temptations of Big Bear.* McClelland (Toronto), 1973. Fiction.

SASKATCHEWAN, UNIVERSITY OF, is a coeducational university in Saskatoon, Sask. It is supported largely by the province.

The university has colleges of agriculture, arts and science, commerce, dentistry, education, engineering, graduate studies, home economics, law, medicine, pharmacy, physical education, and veterinary medicine. It also has departments of art and music, and schools of nursing and religious studies. The university grants bachelor's, master's, and doctor's degrees.

Four theological schools—the College of Emmanuel and St. Chad, Lutheran Theological Seminary, St. Andrew's College, and St. Thomas More College—are associated with the university. The university also has an extension division. The University of Saskatchewan was founded in 1907. For enrollment, see CANADA (table: Universities and Colleges). J. W. T. SPINKS

SASKATCHEWAN REBELLION, or SECOND RIEL REBELLION, was an uprising of the *métis* (persons of mixed French and Indian descent) in Canada in 1885. Louis Riel led the revolt (see RIEL, LOUIS). In 1869 and 1870, the métis took part in the Red River Rebellion in Manitoba (see RED RIVER REBELLION). After that rebellion, the Canadian government gave 240 acres (97 hectares) of Manitoban land to each of the dissatisfied métis. At first, this satisfied the métis.

But Manitoba soon began to fill with settlers from eastern Canada. Many of the restless métis gave up their land grants and drifted westward to the Saskatchewan River Valley. There they were again disturbed by the advance of the settlements. The Indians and the métis were afraid that the settlers would destroy the buffalo herds upon which they depended for food and clothing. They had no legal titles to the lands where they lived, and feared that they would lose their homes. They disliked the government's method of surveying and laying out farms. They preferred the old French system by which farms were narrow strips along the river.

In 1884, the métis asked Riel to come to Saskatchewan to help them uphold their rights. Riel, who was living in Montana at the time, agreed to come. In March, 1885, Riel helped the métis set up a provisional government at Saint Laurent. Riel was moderate at first, and there seemed to be a possibility that the government and the métis would reach a compromise.

This possibility vanished when a skirmish between the métis and the mounted police took place at Duck Lake. An uprising of the Cree Indians followed the trouble at Duck Lake. Led by Chief Big Bear, the Cree

attacked a settlement at Frog Lake, where they killed the men and carried off the women and children.

The news of this outbreak aroused the people of eastern Canada. A force of 4,400 men was sent into the Saskatchewan territory, and the métis were quickly defeated. Riel surrendered and was hanged for treason.

The Saskatchewan Rebellion had important results. The Canadian government recognized the claims of the métis, and gave them legal titles to their lands. The rebellion showed the increasing importance of the North West (later Northwest) Territories, and they were given representation in Parliament. The rebellion also gave white people in the west a sense of belonging to Canada. However, the rebellion heightened racial hatred between French and English Canadians in the east, and it has never been entirely forgotten. P. B. WAITE

See also CROWFOOT; DUMONT, GABRIEL; POUNDMAKER.

SASKATCHEWAN RIVER begins in Alberta, Canada. Two branches join to make the stream. The river flows across Alberta and Saskatchewan and part of Manitoba. The North Saskatchewan rises west of Edmonton in glaciers in the Rocky Mountains. The South Saskatchewan is formed by the Bow and Oldman rivers near Grassy Lake. The branches flow east, and join near Prince Albert in Saskatchewan. The river then flows east into Manitoba, and empties into the northwest side of Lake Winnipeg. The Nelson River flows from the northeast side of Lake Winnipeg to the Hudson Bay.

The branches of the South Saskatchewan are widely used for irrigation in southern Alberta. Gardiner Dam, near Outlook, Sask., provides hydroelectric power, irrigation, and lake recreation facilities. JOHN BRIAN BIRD

SASKATOON, *SAS kuh TOON*, Sask. (pop. 126,449), is a major trading center of Western Canada. It ranks second to Regina as the largest city of the province of Saskatchewan. Saskatoon lies on the South Saskatchewan River in the middle of the prairies that spread across Western Canada. For location, see SASKATCHEWAN (political map).

Settlers from Ontario founded Saskatoon in 1883. They chose the site because it was ideal for ferry and steamboat traffic. The settlers named the town for a berry that grows along the banks of the river.

Description. Saskatoon covers about 40 square miles (101 square kilometers) on both sides of the South Saskatchewan River. Six bridges connect the two parts of the city. The Western Development Museum in Saskatoon features one of the largest collections of antique cars, early farm equipment, and steam engines in North America. The Mendel Art Gallery displays Eskimo sculpture and modern painting. Several sites of the Saskatchewan Rebellion of 1885 are near the city (see SASKATCHEWAN REBELLION).

Saskatoon is the home of the University of Saskatchewan. The university, which has a staff of about 3,600 persons, ranks as the city's largest employer.

Saskatoon serves as the trading center of a farming region of about 70,000 square miles (180,000 square kilometers). The major highways of the region meet in Saskatoon, which is sometimes called the *Hub City*. Saskatoon's leading industries are dairying and meat packing. The Saskatoon area has some of the world's largest deposits of potash, and uranium mines are north of the city.

History. Cree Indians lived in what is now the Saskatoon area before white men first arrived there in 1883. That year, 35 members of the Temperance Colonization Company settled in the area. The settlers, led by John Lake, came from Ontario. They founded Saskatoon, but they failed to achieve their goal of banning alcoholic beverages from the community. The Canadian Pacific Railway reached Saskatoon in 1890. The city's population reached about 5,000 in 1906, when Saskatoon was incorporated as a city.

During the 1930's, dust storms and the resulting crop failures caused great hardship in Saskatoon. Mining of the potash deposits near the city began in the early 1950's. During the 1960's, Saskatoon became an important supply center for Saskatchewan's mining industry, and new factories provided hundreds of jobs for the city's workers. In the mid-1970's, the Canadian government planned construction of an oilseed and grain product development center at the University of Saskatchewan campus in Saskatoon. The center was scheduled for completion in 1976. Saskatoon has a mayor-council form of government. THOMAS COONEY

For the monthly weather in Saskatoon, see SASKATCHEWAN (Climate).

SASQUATCH. See BIGFOOT.

SASSAFRAS, *SAS uh fras*, is a medium-sized tree of the laurel family. It is found in the Eastern United States from Maine west to Iowa and south to Texas and Florida. It also grows as a shrub along roadsides. The spicy taste and fragrance of its green twigs, leaves, and bark identify the sassafras. Its small flowers are pale yellow. Sassafras tea is prepared by boiling the root bark. Oil of sassafras is used to perfume soap. The soft, light wood is used for fence posts and lumber. See also TREE (Familiar Broadleaf and Needleleaf Trees [picture]).

Scientific Classification. The sassafras tree belongs to the laurel family, *Lauraceae*. It is classified as genus *Sassafras*, species *S. albidum*. ELBERT L. LITTLE, JR.

SASSARI. See SARDINIA.

SATAN. See DEVIL.

SATANTA. See KIOWA INDIANS.

SATELLITE, *SAT uh lite* (astronomical), is a body that revolves about a planet. The word *satellite* means *an attendant*. Our moon, which circles the earth in its journey around the sun, is a satellite. The faint or dark bodies that revolve about certain stars and cause their light to dim and brighten are also called satellites. The stars they attend are called eclipsing, or variable, stars. Six planets in our solar system have satellites. These planets are Earth, with 1 satellite; Mars, with 2; Neptune, with 2; Uranus, with 5; Saturn, with 10; and Jupiter, with 12. See the separate planet articles, such as JUPITER. See also MOON. E. C. SLIPHER

SATELLITE, ARTIFICIAL. See SPACE TRAVEL; COMMUNICATIONS SATELLITE; SPUTNIK.

SATIE, *sah TEE*, ERIK (1866-1925), a French composer, was a leader in the development of modern music. His unusual treatment of harmony and musical forms—though widely criticized and ridiculed—has influenced many composers. Satie criticized the music of the 1800's for what he considered its complexity, formality, and snobbery. He aimed at creating simple music that anyone could enjoy and perform.

Satie barely earned a living as a pianist in a Parisian cafe. He gained a reputation as an eccentric for his unorthodox music and its odd titles, such as *Truly Flabby Preludes for a Dog* (1911). He also wrote nonsensical performance directions—for example, "to be played like a nightingale with a toothache."

Most of Satie's works are short piano pieces, such as *Descriptions Automatiques* (1913). A leading ballet company, Les Ballets Russes de Diaghilev, commissioned him to write two theater pieces, *Parade* (1917) and *Mercure* (1924). Erik Alfred Leslie Satie was born in Honfleur, France, near Le Havre. JOSEPH BLOCH

SATIN, *SAT uhn*, is a weave in which the *weft* (crosswise yarns) do not cross the *warp* (lengthwise yarns) as often as in a plain weave. The fabric is smooth and shiny. *Satin* also refers to silk, nylon, and rayon or cotton fabrics with a satin weave. KENNETH R. FOX

SATIN GLASS. See GLASSWARE.

SATIRE is the use of irony or sarcasm to attack some form of human behavior. Most satire appears in literature, but satire also plays a part in cartoons, comic strips, drama, motion pictures, and painting. Most satirists claim they want to expose and reform such human failings as greed or vanity. But some satirists simply seem to enjoy ridiculing man's conduct.

The art of satire was perfected by two ancient Roman writers, Horace and Juvenal. The gentle mockery of Horace and the bitter savagery of Juvenal have come to represent two of the main kinds of satire—*Horatian* (mild) and *Juvenalian* (bitter).

Satire appears in all national literatures. The comedies of Aristophanes satirize Greek society of the 400's B.C. François Rabelais' novel *Gargantua and Pantagruel* ridicules French political, religious, and social institutions of the 1500's. Nikolai Gogol poked fun at Russians of the 1800's in his novels and plays.

One of the great periods of satire occurred during the late 1600's and early 1700's in English literature. Most of the important writers of this period wrote brilliant satiric works. For example, Alexander Pope's *The Dunciad* bitterly attacks poets and other writers who he felt abused the English language. Perhaps the greatest work of satire in the English language is Jonathan Swift's *Gulliver's Travels*. Swift wrote this book so clearly and simply that it was adapted into a children's story. But he intended to satirize politics, science, and many other subjects.

The American cartoonists Al Capp, Jules Feiffer, and Walt Kelly are famous for their satire. Leading satirists among artists include William Hogarth of England and Honoré Daumier of France. Preston Sturges of the United States directed many satirical movies.

In the mid-1900's, *black humor* has largely replaced traditional satire. Black humor criticizes human behavior but offers no hope for reform. ROBERT SCHOLES

Related Articles in WORLD BOOK include:

Aristophanes	Gogol, Nikolai	Pope, Alexander
Capp, Al	Hogarth, William	Rabelais, François
Daumier, Honoré	Horace	Sturges, Preston
Dryden, John	Juvenal	Swift, Jonathan
France, Anatole	Molière	Voltaire

SATO, *sah toe*, **EISAKU,** *ay sah koo* (1901-1975), served as premier of Japan from 1964 to 1972. As premier, he supported the United States-Japan Security Treaty under which the United States defends Japan. But he wanted Japan to assume more responsibility for its own defense. Sato resigned in 1972, and Kakuei Tanaka succeeded him. Sato and Sean MacBride of Ireland were awarded the 1974 Nobel peace prize. Sato won the award for his efforts to limit nuclear weapons.

Sato was born in Tabuse, a small town on the Inland Sea. He received a law degree from Tokyo University, and then joined the transportation ministry. During World War II, he directed the operation of the railroads. Later, he became vice-minister of transportation.

Sato was elected to the *Diet* (parliament) in 1949. He served in a series of important party and Cabinet offices until 1954 when he and other top government officials were accused of taking bribes. They resigned. Sato returned to the government four years later in the Cabinet of his brother, Premier Kishi. He also served in Premier Ikeda's Cabinet. When Ikeda resigned because of illness, Sato was selected as premier.

SATRAP, *SAY trap*, was the governor of a *satrapy* (province) in the ancient Persian Empire. The satrap also was tax collector and chief judge of the province. Each satrap kept his own force of bodyguards. Satraps continued to rule after Alexander the Great conquered the empire in 331 B.C. RICHARD NELSON FRYE

SATURABLE REACTOR. See MAGNETIC AMPLIFIER.

SATURATION, *SACH uh RAY shun*, is a term used in chemistry and physics. Chemists say that a solution is *saturated* when no more of a substance will dissolve in it at the same temperature and pressure. A solution in which more of a substance will dissolve is called *unsaturated*. In *saturated organic compounds*, a single bond connects each carbon atom to four other atoms (see BOND [chemical]). Saturated compounds do not have double or triple bonds. A *saturated color* is not mixed with white. See also EVAPORATION. W. NORTON JONES, JR.

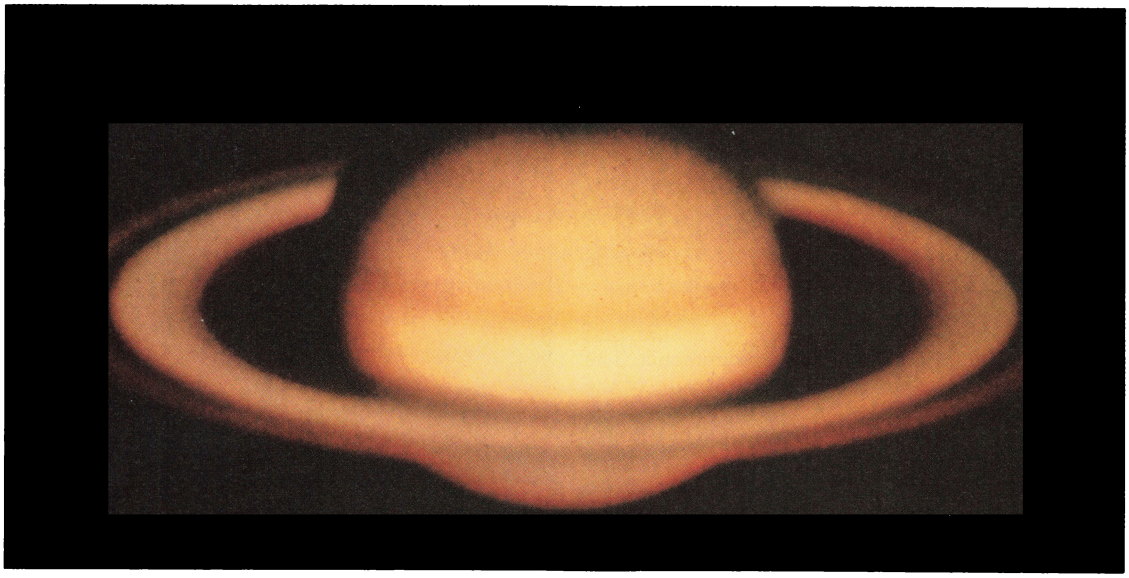
SATURDAY, called *Saeter-daeg* by the Anglo-Saxons, is the seventh day of the week. It is named for the Roman god Saturn and is the only day named for a Roman god. Saturday is the Sabbath among the Jews and the Seventh-day Adventists. Most employers give their workers a half or full holiday on Saturday. See also WEEK. GRACE HUMPHREY

SATURN was an early god in Roman mythology. The ancient Romans probably considered him the god of fertility and planting, but few myths about him remain. His name is probably Etruscan in origin. At first, Saturn had a separate identity. Later, the Romans identified him with the Greek god Cronus. Saturn's wife was Ops, the goddess of fertility and the harvest.

Each year, the Romans honored Saturn with a festival called the Saturnalia. The festival began on December 17 and lasted seven days. During this period, schools and businesses closed, no criminals could be punished, and Roman armies could not start wars. Slaves and masters became equals. Most rules of public conduct were suspended, and entire communities engaged in wild celebration.

Some scholars believe that several modern Christmas customs came from the Saturnalia. These customs include feasting and giving gifts. C. SCOTT LITTLETON

See also CRONUS; SATURNALIA.



Hale Observatories

The Three Rings of Saturn are a spectacular sight when the planet is viewed through a telescope. Only two of the rings are visible in this photograph, because the inner ring is so small.

SATURN is the second largest planet. Only Jupiter is larger. Saturn differs from all the other planets because there are three thin, flat rings around it. These rings are made up of swarms of tiny particles that travel around the planet. The gleaming rings make Saturn one of the most beautiful objects in the solar system.

Saturn's diameter at its equator is about 75,100 miles (120,900 kilometers), almost 10 times that of the earth. Saturn can be seen from the earth with the unaided eye, but the rings are visible only through a telescope.

Saturn was the farthest planet from the earth that the ancient astronomers knew about. They named it for the Roman god of agriculture.

Orbit. Saturn is the sixth closest planet to the sun. Its mean distance from the sun is about 887,500,000 miles (1,428,300,000 kilometers), compared with about 93,000,000 miles (150,000,000 kilometers) for the earth. At its closest approach to the earth, Saturn is about 793,000,000 miles (1,276,000,000 kilometers) away.

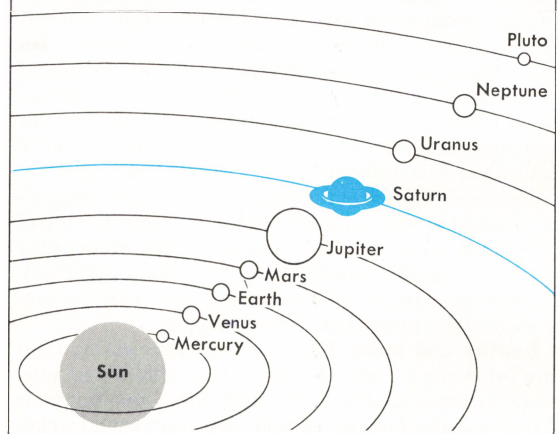
Saturn travels around the sun in an *elliptical* (oval-shaped) orbit. Its distance from the sun is about 937,000,000 miles (1,508,000,000 kilometers) at its farthest point to about 838,000,000 miles (1,349,000,000 kilometers) at its closest point. Saturn takes about 10,759 earth-days, or about 29½ earth-years, to go around the sun, compared with 365 days, or one year, for the earth.

Rotation. As Saturn travels around the sun, it spins on its *axis*, an imaginary line drawn through its center. Saturn's axis is not *perpendicular* (at an angle of 90°) to the planet's path around the sun. The axis tilts at an angle of about 27° from the perpendicular position. For an illustration of the tilt of an axis, see PLANET (The Axes of the Planets).

The contributor of this article is Hyron Spinrad, Professor of Astronomy at the University of California in Berkeley.

SATURN AT A GLANCE

Saturn, shown in blue in the diagram, is the sixth closest planet to the sun. Astronomers still use the ancient symbol for Saturn, *right*. ♄



Distance from Sun: *Shortest*—838,000,000 mi. (1,349,000,000 km); *Greatest*—937,000,000 mi. (1,508,000,000 km); *Mean*—887,500,000 mi. (1,428,300,000 km).

Distance from Earth: *Shortest*—793,000,000 mi. (1,276,000,000 km); *Greatest*—1,030,000,000 mi. (1,658,000,000 km).

Diameter: About 75,100 mi. (120,900 km).

Length of Year: About 29½ earth-years.

Rotation Period: 10 hours and 14 minutes.

Average Temperature: −240° F. (−151° C).

Atmosphere: Hydrogen, helium, methane, ammonia (?).

Number of Satellites: 10.

SATURN

Saturn rotates faster than any other planet except Jupiter. Saturn spins around once in only 10 hours and 14 minutes, compared to about 24 hours, or one day, for the earth. The rapid rotation of Saturn causes the planet to bulge at its equator and flatten at its poles. The planet's diameter is 8,000 miles (13,000 kilometers) larger at the equator than between the poles.

Surface and Atmosphere. Astronomers do not know exactly where Saturn's atmosphere ends and where its surface begins. Only the top of a layer of clouds is visible from the earth. Saturn is so far away that little is known about its surface beneath the clouds.

The atmosphere of Saturn appears to consist of about 70 per cent hydrogen and about 25 per cent helium, plus small amounts of methane and perhaps ammonia. The *atmospheric pressure* (force exerted by the weight of the gases) on Saturn has not been accurately measured. Astronomers estimate the pressure near the top of Saturn's clouds to be close to the earth's atmospheric pressure of 14.7 pounds per square inch (1.03 kilograms per square centimeter). Dark lines that sometimes appear on the clouds show that winds occur in the planet's atmosphere.

The gases that form Saturn's atmosphere also form most of its interior. They are highly compressed in the interior of the planet, and may even be in solid form. In addition to the gases, some rock and other solid material is thought to make up part of Saturn's interior.

The plants and animals that live on the earth could not live on Saturn. Astronomers do not know whether any form of life exists on the planet.

Temperature. The tilt of Saturn's axis causes the sun to heat the planet's northern and southern halves unequally, resulting in seasons and temperature changes. Each season on Saturn lasts about $7\frac{1}{2}$ earth-years, because Saturn takes about 29 times as long to go around the sun as the earth does. Saturn's temperature is always much colder than the earth's, because Saturn is so far from the sun. The average temperature at the top of Saturn's clouds is about −240° F. (−151° C).

Astronomers believe the temperatures below Saturn's clouds may be somewhat higher than those at the top of the clouds. They also have found that the planet may give off a little more energy than it receives from the sun. If these ideas prove to be correct, Saturn may be considered to act somewhat like a weak star.

Density and Mass. Saturn has a lower *density* than any other planet (see DENSITY). It is only about one-tenth as dense as the earth, and about two-thirds as dense as water. That is, a portion of Saturn would weigh much less than an equal portion of the earth, and would float in water.

Although Saturn has a low density, it has a greater *mass* than any other planet except Jupiter (see MASS). Saturn is 95 times as massive as the earth. The force of gravity is a little higher on Saturn than on earth. A 100-pound (45-kilogram) object on earth would weigh about 116 pounds (53 kilograms) on Saturn.

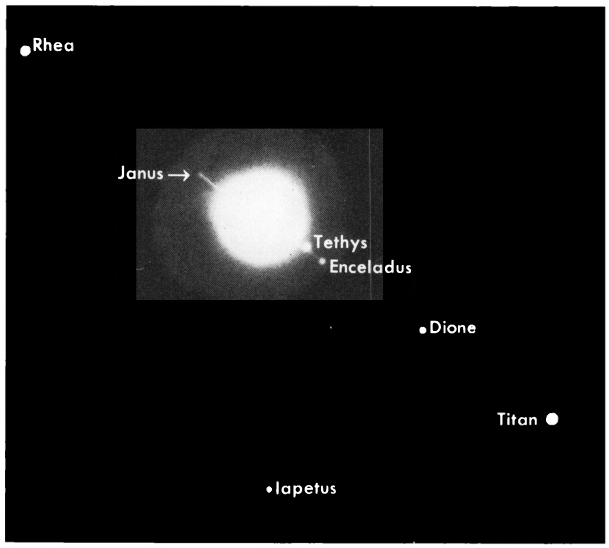
Rings. The rings of Saturn surround the planet at its equator. They do not touch Saturn. As Saturn orbits the sun, the three rings always tilt at the same angle as the equator. Because of this tilt, the rings can be seen at various angles when viewed through a telescope.

The countless tiny particles that make up the rings are too small and too close together to be seen individually. Astronomers estimate their average diameter to be about $\frac{1}{10}$ inch (2.5 millimeters). The particles appear to be ice crystals or objects covered with ice.

Saturn's outermost ring is about 10,000 miles (16,000 kilometers) wide. It has a diameter of about 170,000 miles (274,000 kilometers)—more than twice the diameter of Saturn itself. Between the outer ring and the middle ring is an empty space about 3,000 miles (4,800 kilometers) wide. The middle ring is the brightest of the three rings. It is about 16,000 miles (25,700 kilometers) wide. The innermost ring is difficult to see because it is relatively small and almost transparent. Astronomers know little about it. There is an empty space about 7,000 miles (11,000 kilometers) wide between the innermost ring and the visible surface of Saturn.

The thickness of the rings appears to be less than 10 miles (16 kilometers). This small thickness and extremely large outer diameter can be compared to those of a circular sheet of tissue paper 1 foot (30 centimeters) in diameter. The rings are so thin that they cannot be seen when they are in direct line with the earth.

Saturn's rings were discovered in the early 1600's by the Italian astronomer Galileo. Galileo could not see

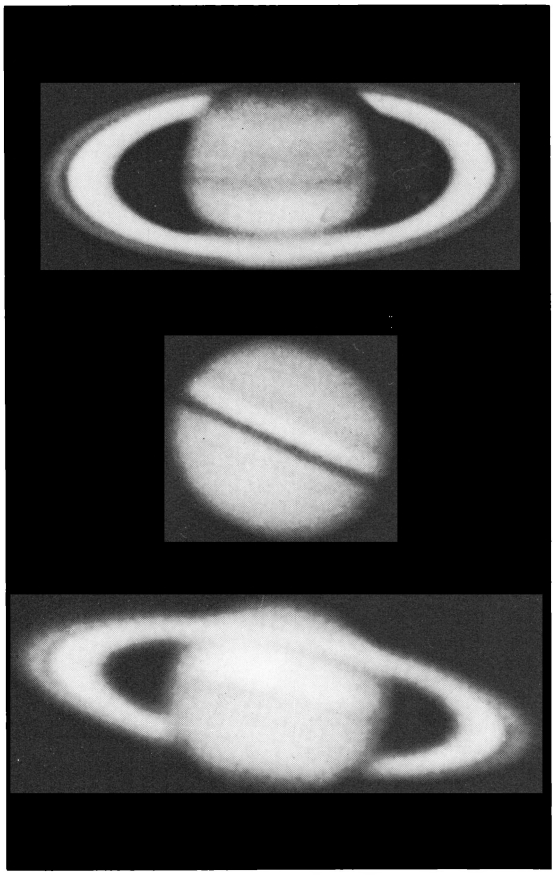


U.S. Naval Observatory

Seven of Saturn's 10 Satellites can be seen in a photograph taken when Janus was discovered in December, 1966. Janus is visible only when the rings "disappear" from view.

SATELLITES OF SATURN

Name	Mean distance from Saturn In mi.	Mean distance from Saturn In km	Diameter of satellite In mi.	Diameter of satellite In km	Year of discovery
Titan	759,000	1,221,000	3,100	4,990	1655
Rhea	327,000	526,300	1,150	1,851	1672
Iapetus	2,210,000	3,557,000	800	1,300	1671
Dione	234,000	376,600	800	1,300	1684
Tethys	183,000	294,500	750	1,210	1684
Enceladus	148,000	238,200	370	595	1789
Mimas	115,000	185,100	320	515	1789
Hyperion	920,000	1,480,000	300	480	1848
Phoebe	8,034,000	12,929,000	190	306	1898
Janus	95,000	153,000	190	306	1966



E. C. Slipher, Lowell Observatory

The Position of Saturn's Rings appears to change as the planet orbits the sun, but the rings are always parallel to Saturn's equator. The rings, less than 10 miles (16 kilometers) thick, seem to vanish when in line with the earth (middle photo).

the rings clearly with his small telescope, and thought they were large satellites. In 1655, using a more powerful telescope, Christian Huygens, a Dutch astronomer, described a "thin and flat" ring around Saturn. Huygens thought the ring was a solid sheet of some material. In 1675, Jean Domenique Cassini, a French astronomer, announced the discovery of two separate rings made up of swarms of satellites. Later observations resulted in the discovery of the innermost ring.

Satellites. In addition to its rings, Saturn has 10 large *satellites* (moons). All of them travel around the planet beyond the rings. Only Jupiter has more large satellites.

Saturn's largest satellite, Titan, has a diameter of about 3,100 miles (4,990 kilometers), about 940 miles (1,510 kilometers) larger than the diameter of the earth's moon. Titan is the only satellite in the solar system that has an atmosphere. It is surrounded by methane gas. Saturn's other satellites are all much smaller than the earth's moon.

Until 1966, astronomers had seen only nine satellites traveling around Saturn. That year, the French astronomer Audouin Dollfus discovered a 10th satellite. This satellite, Janus, travels closer to the rings than any of Saturn's other large satellites.

Flights to Saturn will probably not be attempted for many years. Saturn is almost 800 million miles (1.3 billion kilometers) from the earth at its closest approach, and spacecraft will take at least five years to reach the planet. It will be difficult to equip a spacecraft with enough power for such a long time. The spacecraft will be too far from the sun to use the sun's energy for power.

When a spacecraft does reach Saturn, it will send back information that will help astronomers answer many questions about the planet. Photographs will show the thickness of the rings and the size of the satellites that make up the rings. Measurements will help determine what materials make up Saturn's clouds, atmosphere, and interior. Other measurements will be used to find out whether the planet gives off any form of energy. HYRON SPINRAD

See also PLANET; SOLAR SYSTEM.

SATURN ROCKET. See SPACE TRAVEL (Launch Vehicles, Launch Operations).

SATURNALIA, *sat uhr NAY lee uh*, was the name of an ancient Roman festival given in honor of Saturn, the Roman harvest god. The festival began on December 17, and lasted for seven days. On the first day, public religious ceremonies honoring Saturn took place. On the second day, many families offered sacrifices of young pigs.

The Saturnalia festival was a gay occasion. Schools closed and all public business stopped. Courts of law closed their doors, and no criminals could be punished. Families held banquets. Even slaves were free to attend the festival. The last days of the festival were spent visiting and exchanging presents. Some of the gifts were little clay images called *sigillaria*, from the Latin word *sigilla*, which means *small images*. THOMAS A. BRADY

See also SATURN (Roman god).

SATYAGRAHA. See GANDHI, MOHANDAS K.

SATYR, *SAT uhr*, was the name given to gods of the woods in Greek mythology. They were thought to be part human and part goat or horse. In art, they are often shown as men with pointed ears, hooves, and short tails. Often their legs were shown as goats' legs. Young satyrs were mischievous and handsome. Old satyrs were ugly and lazy. They followed the greater gods Pan and Dionysus. See also FAUN; PAN. VAN JOHNSON

SATYR PLAY. See DRAMA (Greek Drama).

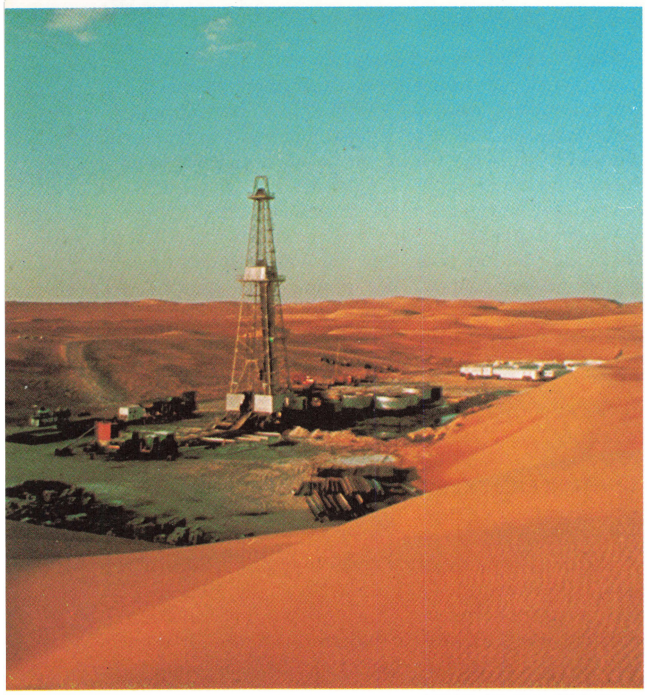
SAUCER, FLYING. See UNIDENTIFIED FLYING OBJECT.

SAUD, *sah OOD* (1902-1969), became Saudi Arabia's second king in 1953, after the death of his father, Ibn Saud. King Saud supported policies friendly to the Western nations. He also helped Jordan maintain its independence. His younger brother, Prince Faisal, seized control of the throne in 1963 when Saud left the country for medical treatment. Saud remained as a figurehead ruler until 1964.

King Saud

Wide World

Saud was born in Kuwait. As his father's agent, Saud traveled widely and visited such countries as Great Britain, India, and Egypt. SYDNEY N. FISHER



Arabian American Oil Company

Tony Howarth, Woodfin Camp, Inc.

Saudi Arabia has become a leading Middle Eastern nation since the development of its oil industry in the mid-1900's. Some of the world's largest oil fields lie beneath the desert in eastern Saudi Arabia, *left*. Oil wealth has promoted the growth of such Saudi cities as Jidda, *right*, a thriving Red Sea port.

SAUDI ARABIA

SAUDI ARABIA is a large Middle Eastern nation that ranks as one of the world's leading producers of petroleum. Much of the country consists of vast deserts where few people live and little or nothing grows. But beneath Saudi Arabia's sand and rock lie some of the largest oil deposits in the world.

Saudi Arabia exports more oil than any other nation. Wealth from these exports has made Saudi Arabia a leading economic power in the Middle East. Oil riches have also made Saudi Arabia a land of contrasts. Cars and trucks speed along highways where camel caravans once provided the only transportation. High-rise apartment buildings are replacing the mud houses that line city streets.

Saudi Arabia includes most of the land region called the Arabian Peninsula. Coastal plains and rugged mountains cover the western part of the country. Most of the central and eastern areas consist of waterless plateaus and deserts. Parts of these dry regions have fertile oases. Saudi Arabia is more than three times as large as Texas.

Most Saudis live in rural areas. Many of the people are farmers or *nomadic* (wandering) herders who tend their camels, goats, and sheep. Since the development of the country's oil industry after World War II (1939-1945), more and more Saudis have moved to cities and towns. These people have jobs in the oil industry and in other fields. Riyadh is the capital of Saudi Arabia.

Nearly all the people of Saudi Arabia are Arab Moslems. The country holds a place of special honor in the Moslem world. Mecca and Medina, the two holiest cities of Islam, are in Saudi Arabia. Moslems from all over the world visit these cities on pilgrimages.

For hundreds of years, the land that is now Saudi Arabia was divided among many warring tribes. The various regions joined together under the leadership of

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FACTS IN BRIEF

Capital: Riyadh.

Official Language: Arabic.

Official Name: Al-Mamlaka Al-Arabiyya Al-Saudiyya (Kingdom of Saudi Arabia).

Form of Government: Monarchy.

Area: 831,313 sq. mi. (2,153,090 km²). *Greatest Distances*—north-south, 1,145 mi. (1,843 km); east-west, 1,290 mi. (2,076 km). *Coastline*—1,174 mi. (1,889 km) on the Red Sea; 341 mi. (549 km) on the Persian Gulf.

Elevation: *Highest*—10,279 ft. (3,133 m) above sea level, in the Asir region near Abha. *Lowest*—sea level.

Population: *Estimated 1976 Population*—9,157,000 (United Nations estimate; some sources estimate the population at about 5,000,000); distribution, 28 per cent urban, 72 per cent rural; density, 10 persons per sq. mi. (4 per km²). *Estimated 1981 Population*—10,512,000 (United Nations estimate).

Chief Products: *Agriculture*—camels, citrus fruits, dates, goats, rice, vegetables, wheat. *Manufacturing*—cement, fertilizer, food products. *Mining*—petroleum.

National Anthem: "Al-Salaam Al-Malaka As-Saudi" ("Royal Anthem of Saudi Arabia").

Money: *Basic Unit*—riyal. For the value of the riyal in U.S. dollars, see MONEY (table: Values).

the Saud family during the early 1900's. The Kingdom of Saudi Arabia was proclaimed in 1932. Saudi Arabia remained a poor, backward nation until the mid-1900's, when income from the oil industry enabled the country to begin modernization programs.

Government

National Government of Saudi Arabia is a monarchy based on the laws of Islam. The king holds executive and legislative powers. He is both the chief political leader and *imam* (supreme religious leader). The country has no formal constitution. The *sharia*, the body of Islamic law, regulates most public affairs. The king issues royal decrees dealing with matters not covered by the sharia. Traffic regulations, for example, are established by such decree law.

The royal family consists of several thousand persons and is the most important political group in Saudi Arabia. Leading members of the royal family select the king from among themselves. Their choice must be approved by a group of Moslem religious leaders called the *ulema*. To stay in power, the king must have the support of the royal family, the ulema, and local tribal leaders. The king appoints a Council of Ministers to assist him in managing the government. Council members advise the king on policy, develop legislation, and administer various government departments. The king himself serves as prime minister. Close relatives of the king hold many important council positions.

Local Government. Saudi Arabia is divided into 18 provinces. A governor appointed by the king heads each province. Provincial councils assist the governors. Several Saudi Arabian cities elect municipal councils that handle local government affairs. Tribal leaders govern smaller towns and villages.

Courts. A system of religious courts handles all civil and criminal cases based on the sharia. A *qadi* (judge) presides over each court. There are no juries. The king himself represents the highest court of appeal. In cases involving decree law, leaders of local governments act as judges. In such cases, a Grievance Board, made up of members of the Council of Ministers, serves as the final court of appeal.

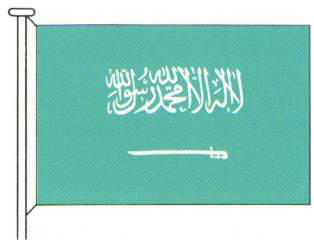
Armed Forces. A total of about 40,000 men serve in Saudi Arabia's army, navy, and air force. All military service is voluntary. Saudi Arabia also has a National Guard that handles internal security matters. The United States has provided Saudi Arabia with military training and most of its modern military equipment.

People

Population and Ancestry. The Saudi government conducted a census in 1974, but did not release the results. The United Nations (UN) estimates Saudi Arabia's population at 9,157,000. Other estimates place the population at about 5 million. Nearly all Saudis are Arab Moslems. They are descended from Semitic tribes that settled in the Arabian Peninsula several thousand years ago. The largest minority groups consist of people from other Arab nations who came to Saudi Arabia because of job opportunities in teaching, the oil industry, and other fields. Other minority groups include non-Arab Moslems from Africa and Asia. Many of

Fred Ward, Black Star

The Royal Palace in Jidda is one of several official residences of the king of Saudi Arabia. The king serves as head of state and of the government and is also the nation's religious leader.



The Flag of Saudi Arabia was adopted in 1973. It has a sword and a Moslem religious inscription written in Arabic.

The Coat of Arms features a palm tree and two swords. The symbols appear in the traditional Moslem color, green.

WORLD BOOK map

Saudi Arabia is a large Middle Eastern country. It covers most of the Arabian Peninsula from the Red Sea to the Persian Gulf.

Tony Howarth, Woodfin Camp, Inc.

Outdoor Markets sell food and other products to Saudi shoppers. The men shown above, like most people in Saudi Arabia, wear headcoverings and long robes for protection from the sun.

Tor Eigeland, Black Star

The Bedouins of Saudi Arabia live in temporary campsites in the country's vast desert regions. These nomadic herders roam from place to place with their camels, goats, and sheep.

these people originally came to Saudi Arabia on pilgrimages before settling there permanently.

Only about a fourth of the people of Saudi Arabia live in urban areas. Riyadh and Jidda, the largest cities, have populations of about 300,000. Mecca is the only other city with more than 100,000 people. The number of urban dwellers in Saudi Arabia has increased rapidly since the mid-1900's. Several new urban areas have developed near the oil fields in eastern Saudi Arabia. See HOFUF; JIDDA; MECCA; MEDINA; RIYADH.

About a fourth of Saudi Arabia's rural population lives in farm villages or oasis settlements. The rest of the people are either nomads or seminomads. The nomads, called Bedouins, roam through the vast deserts with their herds of camels, goats, and sheep in search of water and pastureland. The seminomads follow a nomadic way of life part of the year but spend several months in settled rural areas. Since the 1960's, many nomads and seminomads have become settled farmers or have moved to urban areas to work in the oil industry.

Almost all the people of Saudi Arabia use Arabic, the country's official language. English is taught in the secondary schools and is widely used among educated Saudis in business dealings and international affairs.

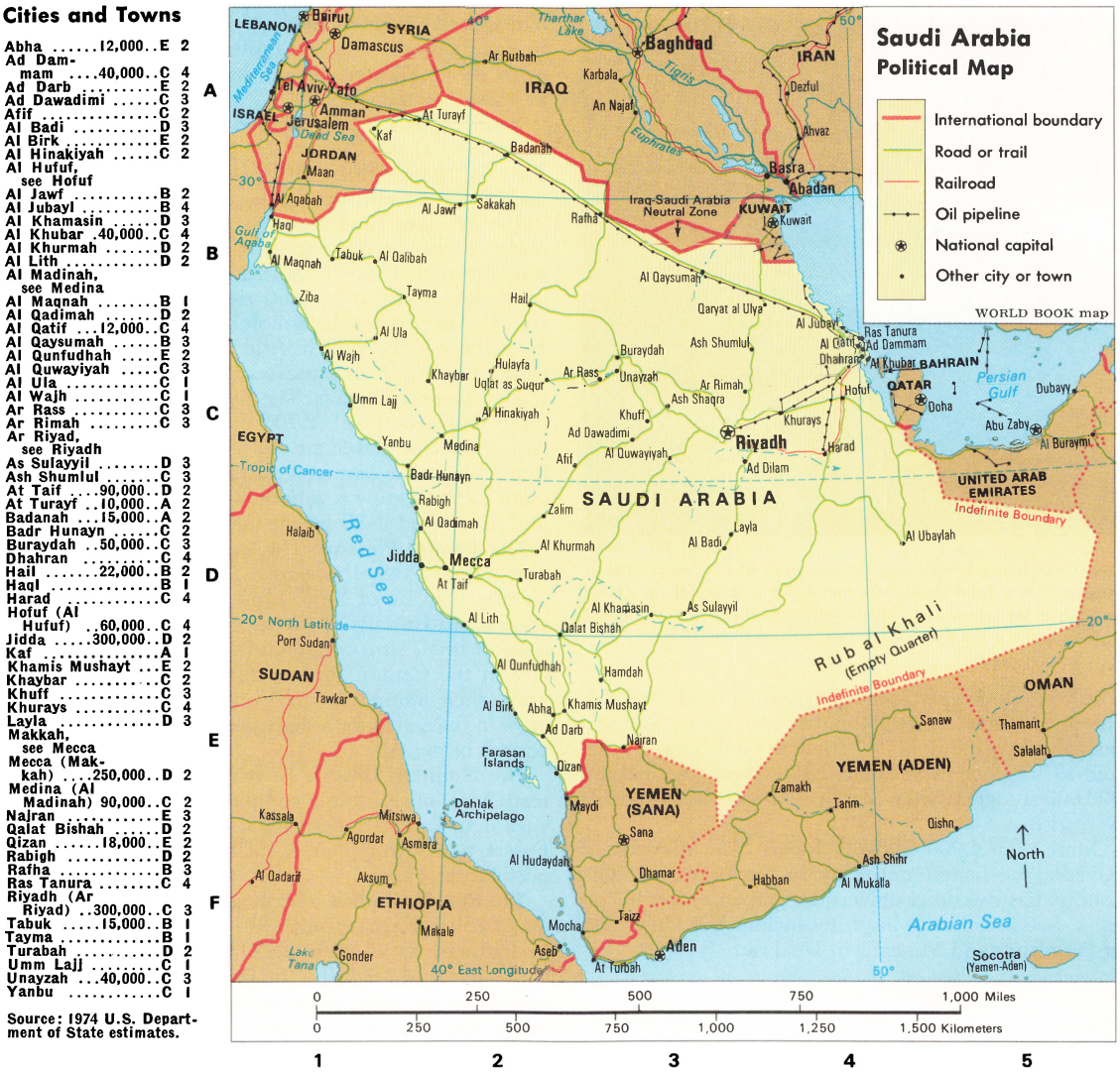
Way of Life. The development of the oil industry has caused many advances in the Saudi way of life, especially in the cities. During the 1960's and 1970's, the country used much of its oil income to build modern schools, transportation systems, and communication networks. The government also took steps to improve housing and to extend electricity and other modern conveniences to remote rural areas.

In spite of these improvements, most rural Saudis still follow a simple way of life. A typical farm village consists of a cluster of one- or two-room houses made of stones or sun-dried mud. The Bedouins, who move from place to place, live in large tents made of animal hides. The village marketplace serves as a social center. There, farmers and Bedouins gather to buy and sell goods and chat with friends. Lively conversation is a favorite form of recreation for Saudis. The people enjoy telling stories and reciting poems or verses from the Koran, the sacred book of Islam.

In Saudi cities, modern apartment buildings have replaced many of the mud houses. Wealthy Saudis have large homes with spacious gardens. Radio and television have become popular forms of entertainment since the 1960's.

Family ties are strong among most Saudis. Although a Saudi father is considered the head of his family, his wife has much authority in running the household. Outside the home, Saudi women have traditionally had little freedom or opportunity for personal advancement. Before 1960, few women received any formal education, and almost none worked outside the home. Since then, the government has improved educational and job opportunities for women. Increasing numbers of women work in such fields as teaching and nursing.

Some of Saudi Arabia's religious leaders have strongly opposed changes in the way of life that have occurred during the mid-1900's. For example, many religious leaders opposed the introduction of television and the education of women. They believed these developments violated the teachings of Islam. Islam continues to have a strong influence over everyday life. But many Saudis, especially young people, believe the country can benefit from modernization without losing its basic traditional values.



Food and Clothing. Dairy products, dates, lamb, and rice are the chief foods of most Saudis. Farmers and city dwellers also eat a variety of fruits and vegetables. Tea and coffee are the most popular beverages. The laws of Islam forbid the eating of pork and the drinking of alcoholic beverages.

Most Saudis, in both urban and rural areas, wear traditional Arab clothes. Men wear a long cotton garment called a *thawb*, which may be covered by a robe, jacket, or cloak. A headcovering called a *keffiyah* (pronounced *kuh FEE yuh*) provides protection against the sun and wind. It consists of a piece of cloth held in place by a rope band. Outside the home, most Saudi women cover their face with a veil and wear a floor-length robe called an *abha*.

Religion. Islam influences family relationships, education, and many other aspects of life in Saudi Arabia. Most Saudis recite prayers five times daily. Other religious rituals include fasting during Ramadan, the ninth month of the Moslem calendar. Each year, more than a million Moslems from Saudi Arabia and other countries go to Mecca on a religious pilgrimage. The pilgrimage is called the *hajj* (see HAJJ).

More than 90 per cent of all Saudis belong to the Sunni branch of Islam. Members of the Shia, another branch, live mainly in the Eastern Province. Almost all the non-Moslems in Saudi Arabia are foreigners.

Education. Less than a fourth of the people of Saudi Arabia can read and write. Since the mid-1900's, the government has established adult education programs and has built hundreds of new schools to improve the country's literacy rate.

The government provides free schooling for Saudi citizens at all levels of education. School attendance is not required by law. Saudi boys and girls attend separate schools. The first public schools for boys were established in 1926. Before that time, the country's only schools were religious institutions called *kuttabs*.

Arabian American Oil Company

Islam has a strong influence on everyday life in Saudi Arabia. Moslems come from throughout the world to pray at the Great Mosque in Mecca, *above*. The cube-shaped building in the center of the picture is the Kaaba, the most sacred shrine of Islam.

The first public girls' schools opened in 1960. In 1953, the country had about 330 public elementary and secondary schools and 44,000 students—all boys. By the mid-1970's, there were about 2,780 schools, with about 800,000 students. More than a fourth of these students were girls.

More than 4,000 students attend the University of Riyadh, the largest university in Saudi Arabia. The country has two other universities and a number of colleges. Saudi technical institutes include the University of Petroleum and Minerals in Dhahran.

The Land and Climate

Saudi Arabia covers 831,313 square miles (2,153,090 square kilometers), or about three-fourths of the Arabian Peninsula. The country consists largely of dry, barren land that slopes downward from west to east. There are no permanent rivers or other bodies of water in Saudi Arabia. During rainstorms, dry valleys called *wadis* fill with water, but the water quickly evaporates or soaks into the ground.

Saudi Arabia can be divided into five land regions. They are: (1) the Western Highlands, (2) the Central Plateau, (3) the Northern Deserts, (4) the Rub al Khali, and (5) the Eastern Lowlands.

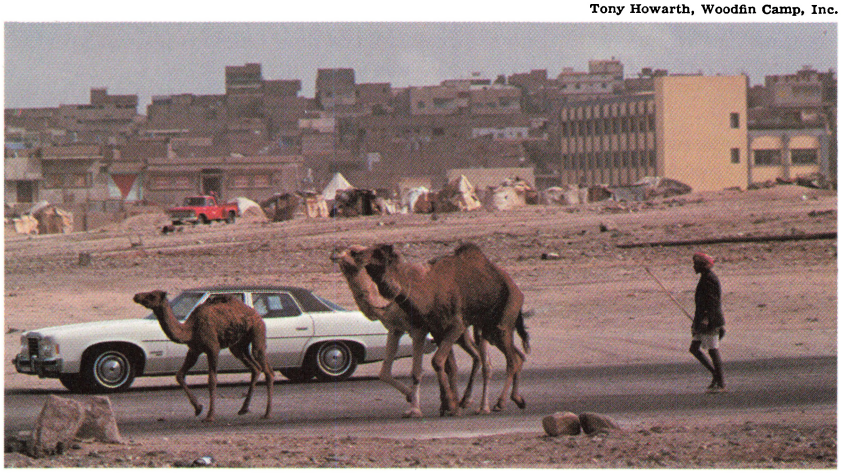
The Western Highlands border the Red Sea. The northern part of this region is called Hejaz, and the southern part is called Asir. Along much of the Hejaz coast, low, rocky mountains rise up sharply from the sea. The mountains slope more gently toward the east. In parts of Hejaz and in Asir, a narrow coastal plain called the Tihamah separates the sea from a ridge of rugged mountain peaks. The highest peaks in Asir rise more than 9,000 feet (2,700 meters) above sea level. Asir is the most fertile area of Saudi Arabia, and small farm villages are scattered throughout much of this region. Farmers grow a variety of crops in the Tihamah and in terraced fields on the mountainsides.

The Central Plateau. The mountains of Hejaz and Asir slope eastward toward a large region called the Central Plateau, or Najd. Most of the region has little vegetation. In parts of the rocky plateau, fertile oases support small farm communities. Riyadh is the largest city in the Central Plateau region. Nomadic herders bring their animals to feed on patches of grass that grow in the region for a short time after occasional brief periods of rainfall.

The Northern Deserts lie north of the Central Plateau. Most of this thinly populated region consists of a vast area of sand dunes called An Nafud. The Syrian Desert, a low-lying plain of rock and gravel, covers the northernmost area.

The Rub al Khali is a huge sandy desert that covers about 250,000 square miles (647,497 square kilometers) of southern Saudi Arabia. This vast, desolate area, whose name in English is the Empty Quarter, is almost as large as the state of Texas. Wind-swept sand dunes reach heights of nearly 1,000 feet (300 meters) in parts of the Rub al Khali. Other areas are flat. The Rub al Khali is uninhabited, except for a few nomadic tribes that travel through it.

Tony Howarth, Woodfin Camp, Inc.



Old and New Ways of Life exist side by side in Saudi Arabia. Modern apartment buildings are replacing mud houses in many Saudi cities and towns, and automobiles share roads with teams of camels.

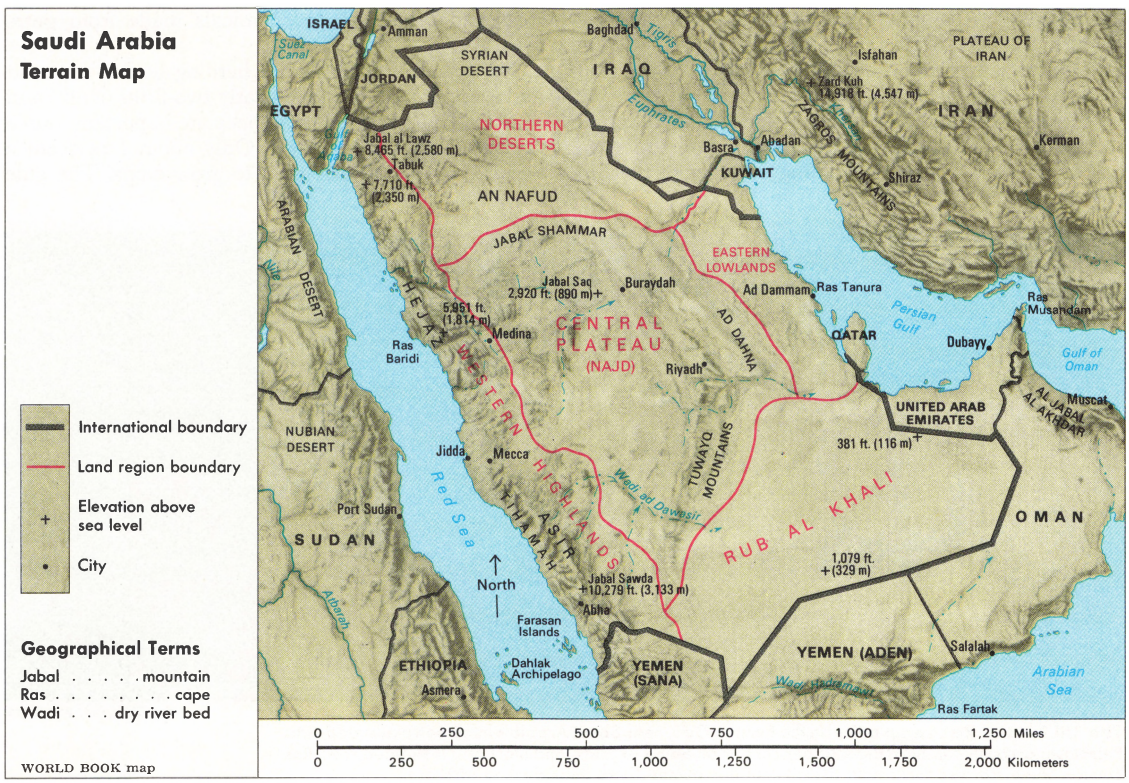
Arabian American Oil Company

The Asir Region of southwestern Saudi Arabia is the country's most fertile area. Saudi farmers use terraced fields to grow crops on the hills and mountains that cover much of the region.

The Eastern Lowlands, also known as Hasa or the Eastern Province, lie along the Persian Gulf. Salt flats extend along parts of the shallow coastline. Sand and gravel cover most of the inland plain, which contains the world's largest known deposits of petroleum. The oil industry has led to the development of Dhahran and several other cities and towns in the lowlands. The region also has a number of fertile oases that support large agricultural settlements.

Climate. Most of Saudi Arabia has a year-round hot climate. The coastal regions are hot and humid during the summer, when the average daytime temperature is over 90° F. (32° C). Summer temperatures in the Central Plateau and the desert regions may reach 120° F. (49° C). But these areas have drier air and cool nights. From November to April, temperatures throughout the country are slightly lower than in summer. Winter temperatures in parts of central, northern, and western Saudi Arabia occasionally dip below freezing.

Asir is the only part of Saudi Arabia that receives much rainfall. Summer *monsoons* (seasonal winds) cause an average annual rainfall in Asir of from 12 to 20 inches (30 to 51 centimeters). The rest of the country receives less than 4 inches (10 centimeters) annually. Parts of the desert regions of Saudi Arabia may have no rainfall at all for several years in a row. A northwesterly



wind called the *shamal* causes frequent sandstorms in eastern Saudi Arabia.

Economy

Saudi Arabia has a rapidly developing economy, based largely on the oil industry and agriculture. The oil industry accounts for more than two-thirds of Saudi Arabia's economic production. But it employs only a small percentage of Saudi workers. Agriculture accounts for only a small share of Saudi Arabia's economic production, yet it employs more Saudi workers than any other economic activity.

Since the 1960's, the government has worked to develop new industries in Saudi Arabia. Such industries would allow the country's economy to keep growing even after the oil resources have been used up. The Saudi government has worked on development programs with the help of business and technical experts from Europe, Japan, the United States, and other parts of the world. A shortage of skilled Saudi laborers has delayed the progress of some of these programs.

Natural Resources. Petroleum is by far Saudi Arabia's most important natural resource. The country's huge oil fields contain about 165 billion barrels of oil—about a fourth of the world's known oil reserves. The oil fields lie in the eastern part of the country and in the Persian Gulf. Saudi Arabia also has small deposits of copper, iron ore, silver, and other minerals. But few of these deposits have been developed.

The Oil Industry is Saudi Arabia's chief source of wealth. The country ranks as the third largest oil producer in the world, after Russia and the United States. In the mid-1970's, Saudi Arabia produced an average of more than 7 million barrels of oil a day. Petroleum and petroleum products account for about 70 per cent of Saudi Arabia's total economic production. But the oil industry employs only about 1 per cent of all Saudi workers. Saudi Arabia exports more petroleum than any other country. It is a leading member of the Organization of Petroleum Exporting Countries (see ORGANIZATION OF PETROLEUM EXPORTING COUNTRIES).

The development of Saudi Arabia's oil industry began in 1933. That year, the Saudi government granted Standard Oil of California the right to explore for and produce oil in Saudi Arabia. Other oil firms later joined the California company. The group of companies became the Arabian American Oil Company (Aramco) in 1944. A major oil deposit was discovered in 1938, but large-scale production did not begin until after World War II ended in 1945. Aramco paid Saudi Arabia a share of its oil profits in return for the right to produce and sell oil. In addition, the company built such things as roads, schools, and hospitals in Saudi Arabia and gave the government technical aid to modernize the economy.

In 1973, Saudi Arabia took over part-ownership of Aramco's facilities and drilling rights. In 1974, the government and Aramco began negotiating for Saudi Arabia to assume total control of the country's oil industry.

Other Industries. Money spent by people who visit Saudi Arabia is another source of income. Most of the visitors are Moslems who go to the country on religious pilgrimages. The construction industry has grown since the 1960's, when thousands of Saudis began working on government-sponsored building projects.

Saudi Arabia does not have many manufacturing industries. The chief manufactured goods include cement, fertilizer, and food products. Government plans for industrial development during the 1970's called for the building of new plants. Planned facilities included automobile assembly plants and factories to produce steel and *petrochemicals* (chemicals made from petroleum).

Agriculture, including the herding done by nomads and seminomads, employs nearly two-fifths of all Saudi workers. Camels, goats, and sheep are important sources of dairy products and meat. Only about 1 per cent of Saudi Arabia's land is used to grow crops. The chief

Tor Eigeland, Black Star

The Oil Port of Ras Tanura lies on the Persian Gulf, near Saudi Arabia's huge petroleum deposits. Petroleum accounts for more than 90 per cent of all Saudi exports, and most of it is shipped from Ras Tanura. Huge storage tanks hold the oil until it is pumped into ships docked offshore.

Tony Howarth, Woodfin Camp, Inc.

Farmers in the Oases of Saudi Arabia rely on irrigation to grow fruits, grains, vegetables, and other crops. Only about 1 per cent of Saudi Arabia's total area is used as cropland.

cultivated areas include Asir in the southwest and the scattered oases of central and eastern Saudi Arabia.

Farmers grow such crops as dates and other fruits, rice, wheat, and vegetables. Dates formerly ranked as the chief crop. However, the introduction of modern irrigation techniques during the mid-1900's enabled Saudi farmers to produce a greater variety of crops. Saudi Arabia's agricultural industry cannot yet produce all the food the nation needs. As a result, Saudi Arabia must import most of its food.

Saudi Arabia has only a small fishing industry. Shrimp caught in the Persian Gulf are the only important seafood product.

Transportation and Communication. Since the mid-1960's, Saudi Arabia has expanded its transportation and communication networks. By the mid-1970's, the country had about 7,000 miles (11,000 kilometers) of paved roads. The country's only railroad, built by Aramco, extends 357 miles (575 kilometers) between Riyadh and the Persian Gulf port of Ad Dammam. The government owns and operates Saudi Arabian Airlines. International airports are located at Dhahran, Jidda, and Riyadh. Ras Tanura, a Persian Gulf port operated by Aramco, handles most of Saudi Arabia's oil exports. The country's other major ports include Ad Dammam, and the Red Sea ports of Jidda and Yanbu.

Five daily newspapers are published in Saudi Arabia. The country also has four radio stations and six television stations. Telephone and telegraph networks serve the cities and major towns.

Foreign Trade. Petroleum accounts for more than 90 per cent of Saudi Arabia's exports. Most of the oil goes to Japan and Western Europe. The United States began to buy large amounts of Saudi oil during the 1970's. Saudi Arabia also exports shrimp. Leading imports include food products, machinery, military equipment, and transportation equipment. The United States, Western Europe, Japan, and Lebanon provide most of the imported goods.

History

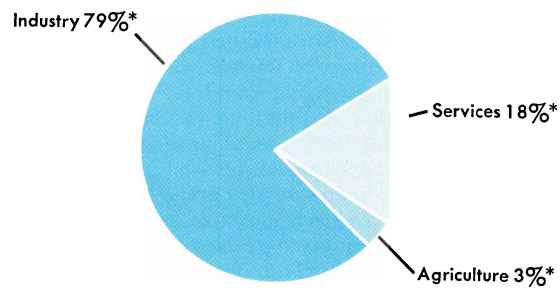
Various Semitic peoples lived in what is now Saudi Arabia several thousand years ago. Bedouin tribes occupied the interior of the Arabian Peninsula. Other peoples established trade centers along caravan routes. These routes linked the Arabian Peninsula with other parts of the Middle East.

A people called the Sabaeans inhabited what are now southwestern Saudi Arabia and Yemen (Sana) around 700 B.C. The Sabaeans became prosperous traders of frankincense, myrrh, and spices. Another group, the Nabataeans, controlled the trade routes in what are now northwestern Saudi Arabia and Jordan from about 350 B.C. to about A.D. 100.

The Rise of Islam. Mohammed, the founder of Islam, was born in Mecca about A.D. 570. At that time,

Saudi Arabia's Gross National Product

Total gross national product in 1974—$26,400,000,000



The gross national product (GNP) is the total value of goods and services produced by a country in a year. The GNP measures a nation's total annual economic performance. It can also be used to compare the economic output and growth of countries.

Production and Workers by Economic Activities

Economic Activities	Per Cent of GDP* Produced†	Employed Workers	
		Number of Persons	Per Cent of Total
Mining	68	36,300	3
Government	7	**	**
Manufacturing	6	70,300	5
Transportation & Communication	4	98,200	8
Construction	4	205,000	16
Wholesale & Retail Trade	3	197,600	15
Agriculture, Forestry, & Fishing	3	482,900	37
Finance, Insurance, Real Estate, & Business Services	3	**	**
Community, Social, & Personal Services	1	191,900	15
Utilities	1	19,600	1
Total	100	1,301,800	100

*GDP is gross domestic product (gross national product adjusted for net income sent or received from abroad).
†1973, latest available figures.
**Included in Community, Social, & Personal Services.
Sources: Saudi Arabian Central Planning Organization; Saudi Arabian Monetary Agency; U.S. Department of State.

most of the people of the Arabian Peninsula worshiped many gods. Mohammed worshiped one God. In Mecca, many people opposed Mohammed. In 622, he and his followers went to Medina. He returned with an army and captured Mecca in 630. Mohammed converted the people of Mecca to Islam. By the time he died in 632, much of Arabia was under Moslem rule.

The Decline of Arabia. During the mid-600's, Mohammed's successors, called *caliphs*, conquered large amounts of territory to the east, west, and north of Arabia. About 660, the caliph Muawiyya moved his capital from Medina to Damascus, in Syria. The Arabian Peninsula then began to decline in importance as the political and religious center of the Moslem empire.

Beginning about 750, the Moslem empire broke up into individual states. For more than a thousand years, numerous warring tribes controlled the various areas that make up most of Arabia. During the early 1500's, the Ottoman Turks gained control over Hejaz and parts of Asir in western Arabia. Britain established protectorates along the southern and eastern coasts of Arabia during the 1800's. But Arabian tribal leaders still ruled most of the vast inland region.

The Saud Dynasty. During the mid-1400's, the Saud *dynasty* (family of rulers) established control over a small area around the town of Dariyah, near what is now Riyadh. The dynasty remained relatively unimportant until the mid-1700's. At that time, the Saudi ruler, Mohammed ibn Saud, formed an alliance with a religious reformer named Mohammed ibn Abd al-Wahhab.

Ibn Abd al-Wahhab strongly opposed a growing disregard of Islamic teachings in Arabia. He preached that the people should return to a strict observance of Moslem laws. The Wahhabi movement, supported by Saudi armies, quickly spread over most of Arabia.

The Saud family enlarged the Saudi state by taking over the regions that were converted to Wahhabism. By the early 1800's, they had captured Mecca and Medina. The Ottoman governor of Egypt then attacked the Saudi state to stop its expansion. Ottoman troops occupied the Hejaz region in 1814. In 1818, they occupied the Najd region and captured the Saudi capital of Dariyah. The Saud family set up a new capital at Riyadh in 1824 and fought to regain its lost land. By 1843, Saudi armies had regained control of most of Arabia.

After 1865, family feuds led to civil war and the weakening of Saudi power. As a result, stronger tribes captured Saudi territory. By 1891, control over most of Arabia was divided among various tribal chiefs and the Ottomans. The leading members of the defeated Saud family fled into exile in Kuwait.

The Founding of Saudi Arabia. In 1902, Abd al-Aziz ibn Saud, a young Saudi leader, led a military raid from Kuwait and captured Riyadh. For the next 25 years, Ibn Saud fought to regain all the territory his ancestors had controlled and to revive the Wahhabi movement.

By 1906, Ibn Saud had taken control of the Najd region. His forces captured Hasa in 1913 and Asir in 1920. In 1925, he conquered Hejaz. Ibn Saud then unified the four regions. In 1932, he proclaimed the union the Kingdom of Saudi Arabia.

The New Kingdom formed by Ibn Saud was isolated and undeveloped. Most of the people were poor farmers or nomads who lived much as their ancestors had lived for hundreds of years before them.

In 1933, Ibn Saud granted Standard Oil of California, an American oil company, the right to look for petroleum deposits in Saudi Arabia. In 1938, the company discovered the first of several large oil deposits. But the start of World War II the following year delayed large-scale oil production.

In 1945, Saudi Arabia became a charter member of the United Nations and the Arab League. After World War II ended in 1945, the oil industry developed rapidly and brought wealth to Saudi Arabia. Ibn Saud began programs of social and economic development. In 1953, he organized a Council of Ministers as a step toward modernizing the government. He named his oldest son, Saud, as his successor. Later that year, Ibn Saud died, and Saud became king. Saud's brother Faisal became crown prince and prime minister.

Saud continued the development programs begun by his father. But Saud was a poor financial manager, and his government spent money unwisely. This led to serious economic problems by the late 1950's. In 1958, Saud gave Faisal control over the government. Faisal restored economic stability. But he resigned as prime minister in 1960 because of disagreements with Saud. Saud again took control of the government.

In 1962, a civil war in Yemen (Sana) caused a crisis between Saudi Arabia and Egypt. Yemeni military leaders had overthrown their government and set up a republic. Egypt supported these rebels, while Saudi Arabia backed Yemeni royalists who fought to restore the former government. The conflict threatened to become a war between Saudi Arabia and Egypt. Tension continued until 1967, when Egypt withdrew its forces from Yemen (Sana).

During the early 1960's, Saud's health weakened, and with it his ability to rule. In 1962, Faisal again became prime minister. That year, Faisal announced a large-scale reform program. He planned to reorganize local governments, promote industrialization, and introduce such new developments as television to Saudi Arabia. In 1964, a council of royal family members and religious leaders forced Saud to give up the throne. They then made Faisal king.

Faisal's Rule brought continued progress to Saudi Arabia. Profits from the oil industry financed the construction of modern hospitals, schools, and apartment buildings. The government improved and expanded the country's transportation and communication systems. At the same time, Saudi Arabia began to take a more active interest in Arab and world affairs.

In 1967, Saudi Arabia supported the Arabs of Egypt, Jordan, and Syria in the Six-Day War against Israel. Saudi Arabia did not send troops. But after the Arabs lost the war, Saudi Arabia promised to give Egypt and Jordan financial aid to help them recover.

The Six-Day War left Israel in control of large sections of Arab territory. This land included part of Jerusalem, one of Islam's holiest cities. During the early 1970's, Faisal took a strong stand against this Israeli occupation. After another Arab-Israeli war broke out in 1973, Faisal used Saudi Arabia's oil as an economic weapon against the nations that supported Israel. Saudi

Arabia and several other Arab oil-producing countries temporarily stopped exporting petroleum to the United States and The Netherlands. They also sharply reduced oil shipments to other countries that they classed as "neutral." The oil cutback created serious fuel shortages in many countries.

During the mid-1970's, oil prices jumped sharply, causing a dramatic increase in Saudi Arabia's wealth. In 1973, Saudi Arabia produced more than 7½ million barrels of petroleum daily and received a total of about $5½ billion in oil revenues. In 1974, the daily oil production increased to about 8½ million barrels, but revenues soared to nearly $23 billion. The increased income enabled the government to plan $60 billion worth of economic developments for the late 1970's. In 1974, Saudi Arabia and the United States signed an agreement to cooperate in such areas as education, science and technology, agriculture, and industrialization.

Saudi Arabia Today. In March, 1975, King Faisal's reign ended abruptly when one of his nephews assassinated him. Prince Khalid, a half-brother of Faisal's, succeeded him as king and prime minister. Khalid made his brother Prince Fahd the crown prince and first deputy prime minister. Khalid was expected to carry on the policies that had been developed by Faisal. Saudi Arabia's oil wealth assured its continuing role as a Middle Eastern and world power. MALCOLM C. PECK

Related Articles in WORLD BOOK include:

Arab	Hejaz	Mecca
Arab League	Hofuf	Medina
Arabia	Ibn Saud	Mining (graph)
Arabian Desert	Ikhwan	Mohammed
Bedouins	Islam	Petroleum
Clothing (picture: Traditional Costumes)	Jidda	Riyadh
Faisal	Kaaba	Saud
	Khalid	

Outline

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III. The Land and Climate
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- D. The Rub al Khali
- E. The Eastern Lowlands
- F. Climate

IV. Economy
- A. Natural Resources
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- C. Other Industries
- D. Agriculture
- E. Transportation and Communication
- F. Foreign Trade

V. History

Questions

What is the English name for the Rub al Khali?

When did the oil industry begin to develop rapidly in Saudi Arabia? How has this industry affected the nation?

What is Saudi Arabia's most fertile region?

What was the Wahhabi movement?

What role does Islam play in Saudi life?

What is an *abha?* a *wadi?* a *keffiyah?*

What is Saudi Arabia's chief natural resource?

When was the Kingdom of Saudi Arabia officially proclaimed?

Why is the *sharia* important in Saudi Arabia's government?

What are Saudi Arabia's chief farm products?

SAUERKRAUT. See CABBAGE.

SAUK INDIANS, *sawk*, or SAC, belonged to the Algonkian language group of the North American eastern forests tribes. They lived with their close relatives, the Fox Indians. They originally made their home in Canada or Michigan, but the Iroquois drove them out. They then settled in southern Wisconsin, northern Illinois, and Iowa. These Indians had a large village where Rock Island, Ill., now stands. They also set up villages in Iowa along the Mississippi River.

The Sauk and Fox lived in long lodges covered with elm bark. When hunting away from the village in winter, they lived in round houses made of stakes covered with matting. The men wore skin clothing long after cloth was available from white traders.

The Sauk and Fox ceded their Illinois lands to the United States in 1804, and most of them moved across the Mississippi. But a famous warrior, Black Hawk, refused to leave the Rock Island village. This led to the Black Hawk War in 1832, and the defeat of his band (see BLACK HAWK). Most Sauk and Fox now live on reservations in Iowa and Oklahoma. WAYNE C. TEMPLE

SAUL was the first king of Israel and one of the most tragic figures in history. He reigned shortly before 1000 B.C. The dramatic story of his life and times is contained in an unusually vivid section of the Old Testament (I Samuel 9-31).

Israel's existence as a nation was threatened by the Philistines, who had mastered the new technique of fabricating iron and had a monopoly of iron weapons. Israel's old system of government under casually chosen judges was not equal to the situation. The people clamored for a king, and the old ruling group reluctantly gave in and picked Saul for the task. At this time, he was only a young member of an insignificant clan.

Saul surprised everybody with his ability. He was brave, generous, and modest, and he would not take orders blindly from the old guard. But the mounting pressures and responsibilities of ruling slowly undermined his personality. He became moody and suspicious, and grew jealous of young David's growing popularity.

Saul won many victories, but when the final test came, at the battle of Mount Gilboa, his outnumbered and poorly equipped army was no match for the Philistines. Mortally wounded, he fell on his sword. He was mourned by friend and foe alike. E. A. SPEISER

See also DAVID.

SAUL OF TARSUS. See PAUL, SAINT.

SAULT SAINTE MARIE, *SOO saynt muh REE*, Ontario (pop. 80,332), stands on the Saint Marys River, which connects Lake Superior and Lake Huron (see ONTARIO [political map]). French missionaries named it for the falls in the river. The Old French word *sault* means *falls*. These falls provide hydroelectric power for plants making pulp and paper, chemicals, lumber, and tar. Sault Sainte Marie has one of the largest iron and steel mills in Canada. Engineers built the International Bridge near the city in 1887, and a canal in 1895 (see SOO CANALS). A highway bridge, which was completed in 1962, connects the city with Sault Ste. Marie, Mich. The French founded a settlement at Sault Sainte Marie in 1668. D. M. L. FARR

SAULT SAINTE MARIE CANALS. See SOO CANALS.

SAUNA. See FINLAND (People).

SAUNDERS, RICHARD. See POOR RICHARD'S ALMANAC.

SAURISCHIAN. See DINOSAUR.

SAUROPOD. See DINOSAUR.

SAUSAGE, *SAW sij*, is a food made of chopped and seasoned meat. The meats used in making sausage include beef, game, pork, poultry, veal, and—in some countries—fish. Sausage is seasoned with herbs and spices, including salt, red and black pepper, sage, garlic, onions, sugar, and ginger. Most sausages contain small amounts of curing agents called *nitrates* and *nitrites*, which give sausages their color. Europeans sometimes add gin or red wine to the sausage they make to give it a special flavor.

Most sausage meat is pressed into a long, round *casing* (skin). Natural casings are made from the intestines of farm animals, especially sheep. Before these casings are used, they are carefully cleaned and salted, or soaked in *brine* (salty water). Casings made of cellulose materials are often used today (see CELLULOSE). Skinless frankfurters are sausages that have their casings removed before the sausages are marketed.

Sausage meat and sausages are important products of the packing industry. In many countries, sausage is also made at home. Fresh sausages are sold raw and may be boiled, fried, or broiled. Other sausages are sold cooked or smoked. They are ready to eat.

The frankfurter, named for Frankfurt, Germany, is the most popular sausage in the world. It is made of cured and well-smoked pork and beef. Experts believe frankfurters were first made in Germany during the Middle Ages. Frankfurters are also called *hot dogs*, *red hots*, and *wienies* in America. Frankfurters served in a bun (usually called hot dogs) are a favorite American food.

Vienna sausage, or *wienerwurst*, looks like a frankfurter but is shorter. It is named for Vienna (Wien), Austria. JOHN C. AYRES

See also MEAT PACKING (picture).

SAUSSURE, FERDINAND DE. See LINGUISTICS (The Structuralists).

SAVA RIVER, *SAH vah*, is a branch of the Danube River in Yugoslavia. The Sava rises in the Carnic Alps, near the southern border of Austria and continues in a southeasterly direction for 450 miles (724 kilometers). It flows through Yugoslavia to Belgrade, where it joins the Danube. Three-fourths of the Sava's course can be used for shipping.

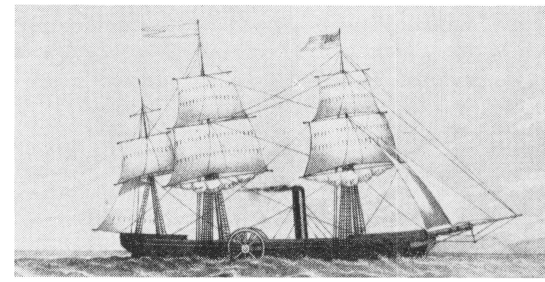
SAVAGE ISLAND. See NIUE ISLAND.

SAVAI'I ISLAND. See WESTERN SAMOA.

SAVANNA, *suh VAN uh*, or SAVANNAH, is any large area of land covered with tall, stiff grasses, and clumps of trees. The grass on savannas grows in bunches and tufts and seldom forms a continuous cover of sod. Most savannas make good grazing for cattle. Many savannas lie between forests and deserts. A good example of this kind of savanna is the grasslands of the Sudan in Africa. These savannas lie between the dense growth of the Congo and the great desert expanse of the Sahara region.

Other savanna areas include the llanos of northern South America, the campos of Brazil, and the veld grasslands of South Africa. The great plains of North America and the steppes of Europe may also be called savannas. The prairies of North America are rich agricultural regions. The savannas of central Africa are the homes of the big game of the world. See also LLANOS; PAMPA; PASTURE; PRAIRIE; STEPPE. ERNEST L. THURSTON

SAVANNAH, nuclear ship. See SHIP (Nuclear Power and Automation; picture).



New York Public Library Picture Collection

The *Savannah* Used Both Steam and Sails for Power.

SAVANNAH was the first steamship to cross the Atlantic Ocean. The *Savannah* sailed from Savannah, Ga., on May 22, 1819, and docked in Liverpool, England, on June 20, 1819. The ship was driven by steam for a total of between 80 and 105 hours. Sails were used the rest of the time.

See also SHIP (Oceangoing Steamships).

Armour and Company

Many Kinds of Sausages are made by meat packers. They include, *left to right*, cervelat, capacola, cooked salami, Genoa salami, B.C. salami, and thuringer.

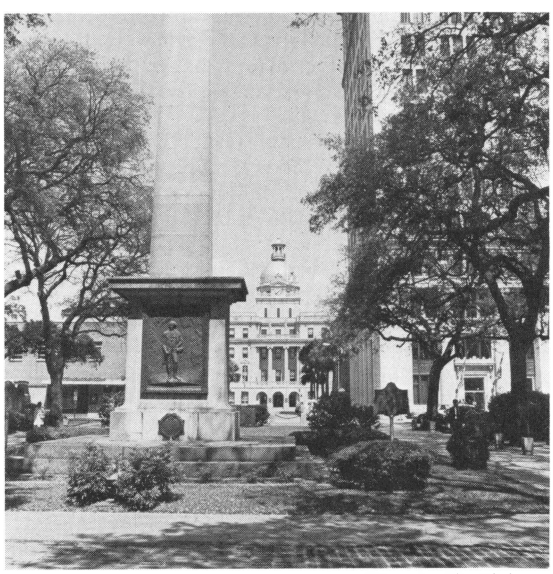
SAVANNAH, Ga. (pop. 118,349; met. area pop. 207,987), is one of the chief Southern ports. It has one of the most up-to-date systems of docks and warehouses in the world. Savannah lies about 18 miles (29 kilometers) inland, across the Savannah River from South Carolina. A channel 40 feet (12 meters) deep connects the city with the Atlantic Ocean. For location, see GEORGIA (political map). For the monthly weather, see GEORGIA (Climate).

Hunter Army Airfield near Savannah and Fort Stewart 40 miles (64 kilometers) south of the city make up the U.S. Army Flight Training Center for helicopter pilots. Armstrong State College and Savannah State College are in Savannah. The Telfair Academy of Arts and Sciences ranks as one of the leading art galleries in the South. The Rev. George Whitefield opened Bethesda, the nation's oldest orphanage, near Savannah, in 1740. Many persons come to Savannah to visit the home of Juliette Gordon Low, who founded the Girl Scouts in the United States.

Industry and Trade. Savannah is the trading center for a large farming region. Sawmills located nearby ship much lumber through Savannah each year. The city's chief industry is the manufacture of kraft, a strong paper used for making bags. Mills make this paper from southern slash pine, which grows around the city. Savannah is an important naval stores center (see NAVAL STORES). Other important products include wood pulp, refined sugar, fertilizer, packaged tea, petroleum products, roofing materials, ships, truck trailers, cement, and aircraft assemblies. Canneries process shrimp, crab meat, and oysters.

History. James Oglethorpe founded Savannah on Feb. 12, 1733, as Georgia's first colonial settlement. Because of this, people call it the *Mother City of Georgia.* Savannah was one of the first planned cities in the United States. Settlers built it according to a design by William Bull and Oglethorpe (see CITY PLANNING [picture]). It was the chief city and capital of the Georgia colony until after the Revolutionary War. Eli Whitney invented the cotton gin near Savannah in 1793. The first steamship to cross an ocean, the S.S. *Savannah,* traveled from Savannah to Liverpool, England, in 1819. General William T. Sherman ended his march to the sea when he captured Savannah in 1864.

In the 1950's, Savannah citizens began a project to restore the old buildings in the city's original section. By the early 1970's, about 1,000 houses had been rebuilt and the restored area had become a popular tourist attraction. Savannah is the county seat of Chatham County and has a council-manager form of government. ALBERT B. SAYE



C. Worden, Tom Stack & Assoc.

Johnson Square in Savannah, Ga., was laid out by colonists in 1733. City Hall, *background,* stands on one side of the square.

SAVANNAH RIVER is a waterway that forms a large part of the boundary between Georgia and South Carolina. Several small streams unite to form the main stream. The rivers rise near the southern boundary of North Carolina and flow together on the boundary of Georgia and South Carolina, southwest of Anderson, S.C. The Savannah then flows southeast and empties into the Atlantic Ocean at Tybee Roads. The Savannah River is 341 miles (549 kilometers) long. A channel 18 miles (29 kilometers) long and 30 feet (9 meters) deep, leads from the ocean to the city of Savannah. Large ships can use this channel. Smaller ships can go 230 miles (370 kilometers) up the river, as far as Augusta, Ga. The Clark Hill Dam above Augusta, Ga., forms a reservoir 38 miles (61 kilometers) long. It supplies power to the Savannah River Atomic Energy Plant in South Carolina. For location, see GEORGIA (physical map). DAVID J. DE LAUBENFELS

SAVANNAH STATE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SAVE THE CHILDREN FEDERATION is a nonprofit organization. It sponsors needy children and schools, without regard to race, creed, or color. The federation collects clothing for welfare and disaster use, and aids rural communities to help their children. It works in the United States and 12 other countries. Its main office is in Norwalk, Conn.

SAVINGS provide a sense of security and independence that cannot be achieved in any other way. This sense of security can be a source of great satisfaction and pride to people. Hoarding money for no useful purpose is miserliness, just as hoarding physical energy, without using it for anything, is laziness. But saving for some definite goal can be a source of real satisfaction.

There are probably as many reasons for saving money as there are ambitions and desires for men and women to have. Some persons who work for others save something from their wages each payday to be able to buy their own businesses some day. Others save in order to buy a home, an automobile, or new furniture; or to take a vacation. Families often save so that their sons and daughters may be able to go to college. A large number of persons save money during their working days so they may have money to live on in addition to their retirement pensions. Almost everyone tries to *save for a rainy day,* putting aside a certain amount of money with which to pay for a sudden illness or some other emergency. Some persons save for these emergencies by buying insurance.

SAVINGS

The practice of thrift is largely a matter of habit. The amount saved is less important than the process of saving itself. Andrew Carnegie once said, "The best way to accumulate money is resolutely to bank a fixed portion of your income, no matter how small the amount."

Some persons believe that saving is not so important as it once was. Many things can be bought on the installment plan, paid for with a little money from each month's wages instead of with funds already saved. Installment buying does make it possible to enjoy many things without first having to save money to pay for them. But some persons often buy more than they can afford on the installment plan. Later payments, plus interest payments on this *borrowed* money, must be made with future income. These installment payments can become a financial strain. The availability of easy credit does not in itself reduce the importance of the savings habit.

Aids to Saving. Most people once saved cash at home, hiding it under mattresses, in sugar bowls, or in some other special place. Many persons mistrusted banks, and most banks were not interested in handling small savings accounts. Only the wealthy could invest in stocks and bonds.

Hoarding cash at home or hiding it in some place is dangerous, because the funds can be lost or stolen. It is also unprofitable, because the money earns no interest. But invested savings are safe, and they earn interest. There are many ways to invest savings, no matter how small the amount.

Government Bonds. The United States government encourages systematic saving on a national basis by selling bonds and savings stamps. Schools encourage students to save part of their allowances and to buy savings stamps every week. This plan starts the savings habit early in life.

Savings Banks. Almost all banks encourage people to save, and most banks have savings departments. Savings banks specialize in this work, and many of them will open an account of as little as $1, or even less.

Credit Unions are cooperative savings and loan groups that help people save in much the same way as savings banks do. The unions are operated by the members who join them. Many credit unions are organized among employees of companies, in labor unions, among farm groups, and in educational, religious, and social institutions.

Stocks and Bonds. A growing number of persons invest their savings in securities, such as common and preferred stocks and corporate bonds. In this way they help furnish capital to industrial companies, and earn interest and dividends for themselves. Since World War II, small stockholders have become an increasingly important factor in industrial financing. Investors in stocks may usually buy as few shares as they like. Some investment firms encourage stockholders to invest a small amount monthly in stocks and bonds. Many companies throughout the United States permit their employees to buy stock in the company at a reduced rate. Another popular form of savings is through investment clubs, in which a group of people agree to pool their money to buy stock in various companies.

Interest. Savings made in the ways discussed in this article earn interest or dividends for the investor. Interest and dividends are a major element in the growth of a savings account or an investment in securities. A sum of money deposited in a savings account on which interest is compounded annually at $3\frac{1}{2}$ per cent will double itself in about 20 years. LEONARD C. R. LANGER

Related Articles in WORLD BOOK include:

Banks and Banking
Bond
Credit Union
Federal Deposit Insurance Corporation
Insurance
Investment
Savings and Loan Association
Savings Bank
Stock, Capital
Stock Exchange

SAVINGS AND LOAN ASSOCIATION is a home-financing and savings organization. It is a *mutual* institution, owned and operated by its shareholders. Its savers, as shareholders, elect a board of directors to manage the organization. Savings and loan associations help individuals pay for the cost of buying, building, repairing, and remodeling homes. They also promote thrift. These organizations are sometimes called *building and loan associations*, *homestead associations*, or *cooperative banks*.

Savings and loan associations receive savings for safekeeping and investment. Technically, the savers buy *shares* of ownership in the associations, but actually their savings are much like deposits in a commercial bank. Associations lend money in the form of first mortgage loans for the purpose of building, buying, or remodeling homes. Borrowers pay off the loan in small monthly amounts, usually over a period of from 12 to 30 years. Savings and loan associations hold about half the mortgages on one- to four-bedroom homes in the United States. These mortgages amount to over $180 billion. Nearly 9 out of 10 dollars of all savings association assets go into home mortgages. Associations also invest some money in government bonds, and maintain some money as a cash balance.

Each association pays its operating costs and other expenses with part of the interest earned on loans and investments. It also invests some money in financial reserves. The rest of the interest, better than one-half of all income, is distributed among the shareholders in the form of dividends.

The first savings and loan association in the United States opened in 1831. Today, more than 6,200 such institutions serve over 35 million savers. The savers hold share accounts worth more than $93 billion. The associations have their own central reserve system, and are controlled by both federal and state laws. In most associations, savings up to $40,000 for each member are insured against loss by the Federal Savings and Loan Insurance Corporation. EDWARD W. REED

See also FEDERAL HOME LOAN BANK BOARD.

SAVINGS BANK. The savings of the average wage earner are often too small to be invested. But the total savings of many wage earners can be invested at a profit. Savings banks receive small deposits and are able to pay interest by profitably investing the merged funds.

State laws often limit the types of investments savings banks can make, minimizing the chance that depositors' money will be lost. Federal laws also regulate savings banks.

There are two classes of savings banks, *mutual* sav-

ings banks and *stock* savings banks. Depositors own mutual savings banks as a group, and share in the profits of the bank. The bank lends about half of these deposits to individuals and businesses, and invests the rest in bonds. Persons who hold stock in the bank own stock savings banks. They divide the profit.

Daniel Defoe, the English author, is credited with originating the idea of the savings bank in 1697. But a Scot, Henry Duncan, is called the *father of savings banks*. In 1810, he founded a savings bank which took in $5,800 in deposits in four years. The first savings banks in the United States were the Philadelphia Savings Society and the Provident Institution of Boston, both founded in 1816. G. L. BACH

See also BANKS AND BANKING; CREDIT UNION; SAVINGS AND LOAN ASSOCIATION.

SAVINGS BOND is a kind of bond issued by the United States government. Through the sale of savings bonds, the federal government borrows billions of dollars in small amounts from many individuals. The person who buys a savings bond agrees to lend his money to the government for a certain length of time. The government agrees to pay interest on the money it borrows. A savings bond is thus a form of government debt.

The best-known savings bond is the *Series E* bond. This savings bond pays an interest rate of 6 per cent when held until it *matures* (comes due) in 5 years. An individual who lends the government $75 will get $100 when the bond matures. This includes $25 interest on his money for the period of the loan. The buyer may cash in the bond after 60 days and get back his original investment. But he receives no interest until the bond is held six months. There are bonds in the *E* series from $25 to $1,000. Each is sold at 75 per cent of its *face* (maturity) value. No one may buy more than $10,000 worth of *Series E* bonds in any single year.

Another type of savings bond is the *Series H* bond, which pays interest at the rate of 6 per cent if held for 10 years. Interest payments are made every six months by U.S. government check. No person may buy more than $10,000 worth of *Series H* bonds in any single year. Interest earned on *E* and *H* bonds is not subject to state and local income taxes.

The United States government first issued savings bonds in the *Liberty Loan* drive during World War I. A new savings bond drive was organized in May, 1941, to help meet the cost of defense. From then until the end of World War II in 1945, more than $54 billion worth of savings bonds were sold. The government has continued to sell savings bonds ever since. The savings bond program is conducted by the Savings Bond Division of the Department of the Treasury. G. L. BACH

See also BOND (picture); NATIONAL DEBT.

SAVONAROLA, *sav oh nuh ROH luh,* **GIROLAMO** (1452-1498), was an Italian friar, a fiery religious reformer, and a preacher. By 1490, he had begun his attempts to reform the city of Florence through preaching. He was a highly emotional, but effective, preacher. His humor, charm, colorful language, and theatrical presentations made him a leading figure. He claimed he had prophetical inspiration, and criticized bitterly the immorality of Pope Alexander VI (see ALEXANDER [VI]). He also predicted punishment of the Roman Catholic Church and Italy.

Pope Alexander VI ordered Savonarola to Rome in 1495 to explain his claim to special revelation, but the friar refused. He said his health and fear of violence on the way made it impossible and stated: "It is not the will of God that I leave Florence." The pope then ordered him to stop preaching.

When Savonarola resumed preaching during Lent in 1496, the pope excommunicated him for disobedience. When he continued his defiance, Alexander VI threatened to place Florence under an *interdict* (ban on worship) unless the city could force him to go to Rome or could force him to be silent until he asked absolution. Savonarola surrendered to the civil authorities. He was tried and condemned by an ecclesiastical court, which turned him over to the civil authorities for punishment. On May 23, 1498, Savonarola was hanged, and his body burned.

Savonarola was born in Ferrara of a noble family. He studied humanism, philosophy, and medicine before he joined the Dominican order in 1474. The English novelist George Eliot portrayed Savonarola's life in her novel *Romola.* JAMES A. CORBETT and FULTON J. SHEEN

SAVOY, *suh VOY,* was, until 1946, the oldest reigning family in Europe. Humbert, count of Savoy, founded the house during the 1000's. The family originally ruled a few small countries on the slopes of the Alps in northwestern Italy. Then it acquired holdings on the plains below the mountains. Genoa was added in 1815. The family extended its rule over all Italy by taking advantage of three wars fought between 1859 and 1871. The House of Savoy lost the Italian throne in 1946. See also VICTOR EMMANUEL. R. JOHN RATH

SAW is a cutting tool that has a metal blade with teeth set at an angle along one edge. Saws can cut wood, stone, metal, plastics, and other material.

Circular Saws each have a round disk or plate with teeth around the edge. Different sizes and shapes of the teeth enable the saw to cut rough or fine work on many different materials. Sawmills use circular saws as large as 7 feet (2.1 meters) in diameter for cutting logs into lumber. Smaller sizes, from 6 to 24 inches (15 to 61 centimeters) in diameter, cut lumber and plywood for wood products.

Band Saws have flexible bands of steel with teeth along one edge. Band saws form an endless belt on a power-driven pulley. They saw straight, curved, or irregular cuts in both wood and metal. Sawmills use large band saws to make lumber.

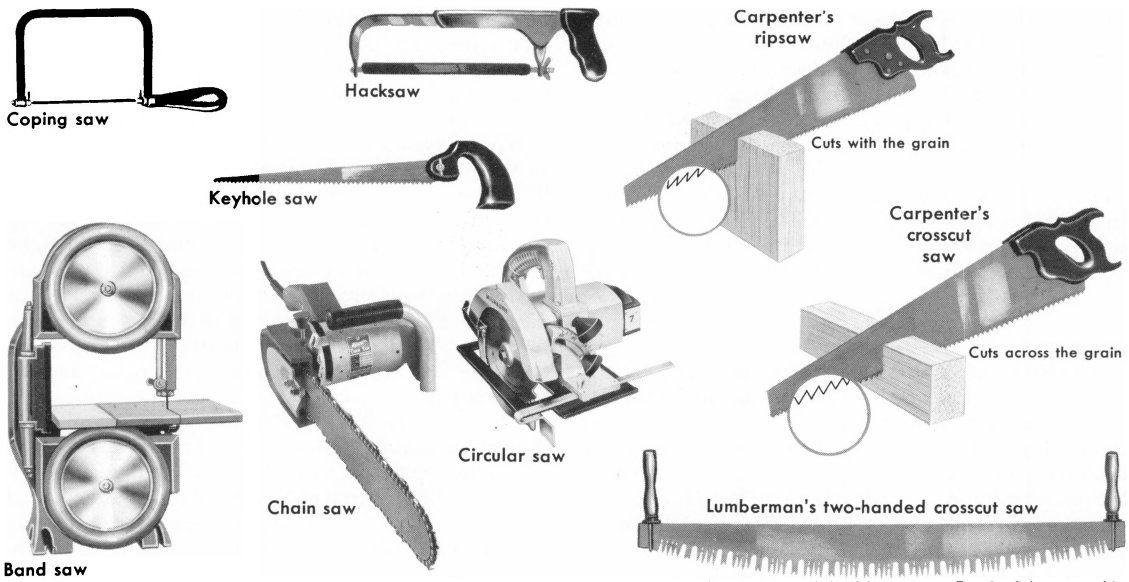
Crosscut Saws cut across the grain of the wood. A *carpenter's crosscut saw* cuts only on the forward thrust. A *lumberman's crosscut saw* cuts on both the forward and backward motion and has a handle at each end.

Chain Saws serve the same general purposes as lumbermen's crosscut saws. But the teeth fit on an endless chain that is run by a gasoline engine or electric motor.

Hacksaws have a narrow blade of hardened steel, and are used chiefly for cutting metal. The operator may run the saw by hand or use power.

Scroll Saws, or *coping saws,* have narrow blades with fine teeth. They cut intricate patterns in thin material. They may be used by hand, or be power driven.

Friction Saws may be made in the form of band saws or circular saws. Sometimes they have no teeth. They run at high speeds, and can cut even the hardest steel.



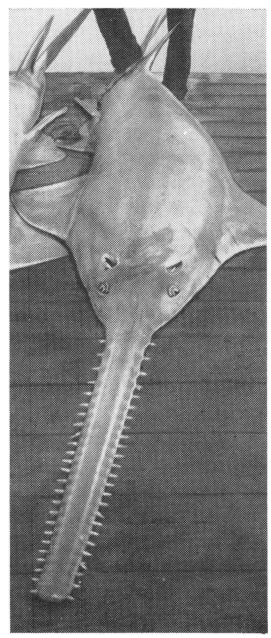
Milwaukee Electric Tool Corporation; *Popular Science* Monthly

The blades move rapidly, and cause the material to become red hot and soft at the point of contact. The blade remains cool because only a part of it touches the material at one time. ARTHUR C. ANSLEY

See also LUMBER (pictures).

SAWBILL. See MERGANSER.

SAWFISH is a fish that lives in the warm parts of the oceans and in some fresh coastal waters. It is a kind of ray. The sawfish can be recognized by its long, flat snout that looks like a saw. The saw shark has a similar snout, but can be told from the sawfish by the position of the gill openings. In the saw shark, these slits are on the side of the neck. In the sawfish, the gill slits are on the undersurface. The snout may be 6 feet (1.8 meters) long. Each side of the snout has many sharp teeth like the teeth of a saw. The sawfish uses its teeth to tear open the body of its victim, and to defend itself against stronger sea animals. Because of its snout, the sawfish is one of the most dangerous of all fish of the sea. There are several species.



Ewing Galloway

Sawfish have sharklike bodies and long snouts, with a single row of teeth on each edge.

Scientific Classification. The sawfish belongs to the sawfish family, *Pristidae*. A common species of sawfish in the United States is genus *Pristis*, species *P. pectinata*. CARL L. HUBBS

SAWFLY is an insect related to ants, bees, and wasps. Female sawflies lay their eggs in the leaves and stems of plants and trunks of trees. A sawlike organ slits the leaf and pushes the egg inside. Most young sawflies resemble caterpillars but they have more legs along their abdomens than caterpillars. Some young sawflies make holes in stems, fruit, wood, or leaves. Some form *galls* (swellings) on leaves or stems. Adult sawflies have four thin wings.

USDA

The Sawfly

The most destructive North American sawflies are those that attack pine, fir, larch, and spruce trees. Other important species damage garden roses, currant bushes, wheat stems, cherry and pear trees, and birch and elm trees.

Scientific Classification. Sawflies belong to the ant, bee, and wasp order, *Hymenoptera*, and make up the sawfly family *Tenthredinidae*. E. G. LINSLEY

SAWMILL. See LUMBER.

SAWYER, RUTH (1880-1970), was an American storyteller and author of books for children. She won the 1937 Newbery medal for *Roller Skates*, a book which tells of a year in her childhood when she explored New York City on roller skates. She won the 1965 Regina Medal. She also wrote *This Way to Christmas* (1924), *Picture Tales From Spain* (1936), *The Long Christmas* (1941), *The Least One* (1941), *The Enchanted Schoolhouse* (1956), and *Daddles* (1964).

The Long Christmas appeared in Dutch in 1950. *The Least One* was published in German in 1952.

Ruth Sawyer was born in Boston, attended the Garland Kindergarten Training School in Boston (now Garland Junior College), and graduated from Columbia University. EVELYN RAY SICKELS

SAWYER, TOM. See TWAIN, MARK; NOVEL.

SAX, ADOLPHE. See SAXOPHONE.

SAXBE, WILLIAM BART (1916-), served as attorney general of the United States in 1974 and early 1975. President Richard M. Nixon chose him to replace Elliot L. Richardson, who had resigned. In 1975, Saxbe became the United States ambassador to India.

Saxbe entered politics in 1946, when he was elected to the Ohio House of Representatives. He later became majority leader and then speaker of the Ohio House. He served as Ohio attorney general from 1957 to 1958 and from 1963 to 1968. In 1968, he won election to the United States Senate. In the Senate, Saxbe, a Republican, gained a reputation for his political independence from the Nixon Administration. For example, he questioned the nation's extended involvement in the Vietnam War and particularly criticized the U.S. bombing of North Vietnam in December, 1972.

Saxbe was born in Mechanicsburg, Ohio. He graduated from Ohio State University in 1940 and received a law degree there in 1948. GUY HALVERSON

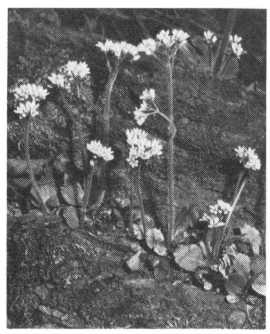
SAXE, COMTE DE (1696-1750), MAURICE DE SAXE, a German soldier of fortune, led French armies to victory in the War of the Austrian Succession (see SUCCESSION WARS). He was made a Marshal of France for his successes over the British in The Netherlands. Saxe was born in Goslar, Germany, the illegitimate son of King Augustus II of Saxony. RAYMOND O. ROCKWOOD

SAXE-COBURG-GOTHA. See WINDSOR (family).

SAXIFRAGE, *SAK suh frihj*, is any one of a group of small, hardy plants that grow in cold and temperate parts of the Northern Hemisphere. The word *saxifrage* means *rock-breaker*. The plants were given this name because they usually grow between mountain rocks.

Saxifrages grow from 2 to 36 inches (5 to 91 centimeters) high. The thick, fleshy leaves grow near the ground. The flower stalk grows straight upward, and bears clusters of white, pink, purple, or yellow blossoms. The blossoms usually have 5 sepals, 5 petals, and 10 stamens.

The *early saxifrage* is one of the most common species. It has white flowers, and blooms as early as April. It grows from southeastern Canada to Georgia and west to Missouri.



A. W. Ambler, NAS

Early Saxifrage has white flowers that bloom early in spring. This plant grows on rocky hillsides.

Scientific Classification. Saxifrages are in the saxifrage family, *Saxifragaceae*. They make up the genus *Saxifraga*. Early saxifrage is *S. virginiensis*. ROBERT W. HOSHAW

See also CURRANT; DEUTZIA; GOOSEBERRY; HYDRANGEA; MOCK ORANGE.

SAXON was a member of a Germanic tribe that invaded the island of Britain about 1,500 years ago. The Angles, another Germanic tribe, invaded Britain about the same time. The two tribal groups mixed and established the Anglo-Saxon kingdom, which lasted until the Norman Conquest of 1066.

The ancient geographer Ptolemy first mentioned the Saxons in a book he wrote during the A.D. 100's. According to Ptolemy, the Saxons lived in an area in southern Denmark called *Saxony* (now Schleswig, in Germany). They were a warlike people who invaded Roman territory in the late 300's, during the reigns of the emperors Julian and Valentinian. By the 500's, the Saxons had settled along the coast of Gaul (now France), between the Elbe and Loire rivers. The Saxons invaded Britain during the mid-400's, conquered the Celts who lived there, and settled in southern and western Britain.

In the 700's, Charlemagne conquered the Saxons still on the continent, forced them to accept Christianity, and made their country part of his empire. The home of the Saxons became part of Germany. BRYCE LYON

See also ANGLO-SAXON; ENGLAND (History).

SAXONY, a region and former state in east-central Germany covers 6,839 square miles (17,713 square kilometers). The East German government abolished it as a political unit in 1952, and divided the region into the districts of Leipzig, Dresden, and Chemnitz (now Karl-Marx-Stadt).

In the 1400's, the eastern part of the Duchy of Saxony came under the rule of the Wettin family, who called it Saxony. Saxony joined the German Empire in 1871. It became a republic after World War I. Russia occupied Saxony after Germany surrendered in World War II. JAMES K. POLLOCK

See also DRESDEN; SEVEN WEEKS' WAR.

SAXOPHONE, *SAK suh fohn*, is a single-reed woodwind instrument made of brass. It combines the conical tubing of the cornet-type instruments with the single-reed tone principle of the clarinet. Military bands

Jim Collins

The Saxophone is a woodwind instrument made of brass. A musician plays different notes by pressing keys that open and close the tone hole sockets.

quickly put the saxophone to use. It has taken an important place in concert bands and dance bands. It is a good solo instrument, and has been used in some important orchestral works, such as Bizet's *L'Arlésienne* suite. Saxophones range in size from the little-used E-flat and B-flat sopranos to the contrabass in E-flat. The E-flat alto and the B-flat tenor are most commonly used. Adolphe Sax (1814-1894), a Belgian instrument maker, invented the saxophone about 1840. CHARLES B. RIGHTER

SAY, JEAN BAPTISTE (1767-1832), a French economist, did much to spread the doctrines of Adam Smith. Say's principal work was *Treatise on Political Economy* (1803). He is credited with dividing the subject of economics into production, distribution, and consumption. He also established a *law of markets*, which stated that there can be no general overproduction of goods. He believed that additional supplies create an additional demand. Say was born in Lyon. H. W. SPIEGEL

SAYERS, DOROTHY (1893-1957), an English author, was one of the most famous writers of detective stories of the 1900's. Her best-known works feature Lord Peter Wimsey, a sophisticated, scholarly amateur detective.

Sayers, the daughter of an Anglican minister, was born in Oxford and graduated from Oxford University. Her Wimsey stories, which reflect her background, involve well-bred characters with graceful manners.

Howard Coster, David Higham Assoc.

Dorothy Sayers

The most popular Wimsey novels include *Whose Body?* (1923), Sayers' first book; *Strong Poison* (1930); *Murder Must Advertise* (1933); *The Nine Tailors* (1934); and *Gaudy Night* (1935). A collection of all the Wimsey short stories appeared as *Lord Peter* (1972).

In 1937, Sayers abandoned detective fiction and turned to religious works. The first of these was a play, *The Zeal of Thy House* (1937). In *Mind of the Maker* (1941), she compared God and man as creative beings. From 1949 until her death, Sayers worked on translations of Dante's *Divine Comedy*. THOMAS A. ERHARD

SCAB, a disease of plants. See APPLE (Diseases); POTATO (Insect Pests); WHEAT (Other Diseases).

SCAB, in labor. See LABOR (Terms).

SCAB, in medicine. See BLOOD (Blood Clotting).

SCABLAND. See WASHINGTON (Land Regions).

SCAFELL PIKE. See ENGLAND (Surface Features).

SCALARE. See ANGELFISH.

SCALAWAG was a white Southerner who worked with Negroes and northern Republicans to control politics in the South after the Civil War. Southern Democrats, who believed these men were "beasts in men's clothing," called them *scalawags*, a term commonly applied to useless cattle. Most scalawags were businessmen and planters who had opposed *secession* (withdrawal) from the Union before the war. Some sought personal gain, but others believed that the South had to discard its prewar social and racial views in order to survive. Scalawags helped to bring about educational and social reforms and to pass laws that allowed Negroes to vote. They gradually disappeared during the 1870's, as Democrats regained control of the South. See also RECONSTRUCTION (Scalawags and Carpetbaggers). FRANK L. KLEMENT

SCALDS. See BURNS AND SCALDS.

SCALE. See ARCHITECTURE (Form); INTERIOR DECORATION (Scale); MAP (Scale); RAILROAD, MODEL (Size).

SCALE, in music. See MUSIC (Sound in Music).

SCALE. Scales are flat plates that form the outer covering of most fishes and of many snakes and lizards. Hardened, horny folds of skin form the scales of reptiles. In most fishes, the scales are bony discs developed from the under skin. But sharks' scales bear enamel on the outer surface and bone on the inner surface. Scales also cover a few mammals, such as the scaly anteater. Scales overlap one another like shingles, and form a protective armor for the softer body beneath. They vary in size, shape, and arrangement, depending on the animal. The wings of butterflies and moths have tiny, downy scales.

In botany, scales are little flaky leaves that cover tree buds and woody plants in cold and temperate climates. These scales shield the buds from sudden temperature changes. The regular pieces of a pine cone are called scales. L. B. AREY

See also SCALE INSECT; FISH (Scales; picture: Kinds of Fish Scales).

SCALE, WEIGHING, is a device used to measure weight. Industries use various kinds of scales to weigh loads ranging from extremely light chemicals to full railroad cars that weigh many tons.

There are four chief kinds of weighing scales. In order of their historical development, they are (1) balances, (2) spring scales, (3) mechanical scales, and (4) electronic scales.

Balances, the oldest type of scale, were used in ancient Egypt about 3000 B.C. They probably developed from the *shoulder yoke*, a device that balanced two loads to make them easier to carry. The two main kinds of balances are the *equal-arm balance* and the *steelyard*.

A simple equal-arm balance consists of a horizontal beam with a pan suspended from each end. The beam is supported at its center by a thin edge of metal or some other hard substance. The object being weighed is placed in one pan. Weights of known quantity are placed in the other pan until the two pans balance. Most balances have a pointer to indicate balanced pans. Scientists use balances to accurately weigh exceptionally light substances.

The steelyard was developed by the ancient Romans about 2,000 years ago. This kind of scale uses a small weight to balance a heavy load. The beam of a steelyard has arms of unequal length. A pan on the shorter arm holds the object being weighed. The load is balanced by moving a weight along the longer arm. Markings on this arm indicate the weight of the load.

Physicians use a type of steelyard to weigh patients. The patient steps onto a platform and weights are moved along a beam to balance the person's weight. Some postal scales are steelyards. See BALANCE.

Spring Scales were invented about A.D. 1700. They consist of a pan or platform that hangs from or rests on a spring. The weight of the object being weighed stretches or compresses the spring. This action moves a pointer on a dial and shows the weight of the load. A bathroom scale is a type of spring scale.

Mechanical Scales, developed in the late 1800's, use a system of levers to balance a load against a known weight. The load is placed on a platform that is supported by two or more connected levers. The levers divide the load so that a small weight can be used to balance a heavy load. The weight of the load on the platform may be thousands of times as great as the balancing weight. A dial attached to the scale indicates the weight of the load.

Industries use large mechanical scales to weigh such heavy loads as trucks and railroad cars. Supermarkets use smaller mechanical scales to weigh food products.

Electronic Scales were introduced during the mid-1900's. They use various electrical methods to measure and indicate weight. Most electronic scales have a device called a *strain gage load cell.* This device measures the amount of pressure caused by the weight of the load placed on the scale. It converts the measurement into an electrical signal and transmits the signal to a weight indicator. The weight indicator converts the signal into a weight reading.

Electronic scales can weigh some heavy loads faster and less expensively than can other kinds of scales. The weight-reading indicator of an electronic scale can be placed up to 2,000 feet (610 meters) away from the scale itself. Many electronic scales can transmit weight readings directly to adding machines, calculators, and computers.

Industries use electronic scales to weigh trucks, railroad cars, and other heavy equipment. Supermarkets use these scales to weigh meat, produce, and other items. JAMES R. IRWIN

SCALE INSECT is one of many kinds of sucking insects that feed on plants. Scale insects cluster on plants, sucking out the juices through their tiny, tubelike beaks. They may weaken a plant so much that it dies.

The female scale insect does the damage. The adult male has no mouth and cannot feed. It lives long enough only to fertilize the female's eggs. Most kinds of female scale insects are oval-shaped. They measure from 0.04 to 1 inch (1 millimeter to 2.5 centimeters) long, depending on the species. The scale insect gets its name from the waxy or scaly shell that covers its body. Some kinds of scale insects hardly look like insects at all. They lack eyes, feelers, and legs, and stay in one spot for most of their lives.

Scientists know of more than 2,000 kinds of scale insects, over 400 of which live in the United States. The *San Jose scale,* one of the best known and most harmful kinds, feeds on many types of fruit trees and shrubs. It was first found in the United States near San Jose, Calif., in about 1880 (see SAN JOSE SCALE). Another scale insect that attacks fruit trees, the *cottony cushion scale,* seemed likely at one time to wipe out all the citrus trees in California. But, in 1890, a scientist found an Australian species of ladybird beetle which fed on the cottony cushion scale. The beetles were let loose in California in time to save the citrus growers from ruin.

Cornelia Clarke

Scale Insects, such as these mealy bugs, attack fruit plants.

Some scale insects are useful to man. Shellac, a varnish, comes from the *lac scale* (see LAC). Cochineal, a dye, comes from the *cochineal scale* (see COCHINEAL). One kind of scale insect is used as jewelry. It lives on roots and covers itself with shells called *ground pearls.*

Scientific Classification. Scale insects are members of the order *Homoptera.* DONALD J. BORROR

SCALLION. See ONION.

SCALLOP, *SKAHL up,* is a shellfish that is used for food. It is a *bivalve mollusk* (animal with a two-pieced shell around its soft, boneless body). Scallops live in shallow waters throughout the world, but some live at depths of $4\frac{1}{2}$ miles (7.2 kilometers).

The scallop shell is made up of two equal rounded valves that usually have fanlike, radiating ribs. At the hinge of the shell, where the ligament unites the two valves, there are two winglike projections that are called *ears.* The inside of the scallop shell is lined with fleshy skin called the *mantle.* The edge of this mantle is folded and fringed with *tentacles* (feelers) and a row of eyes.

Scallops are active, and swim by rapidly opening and closing their valves. When the large adductor muscle closes the valves, the water between them is forced out alternately through openings near the hinge. This action pushes the creature forward in a zigzag fashion.

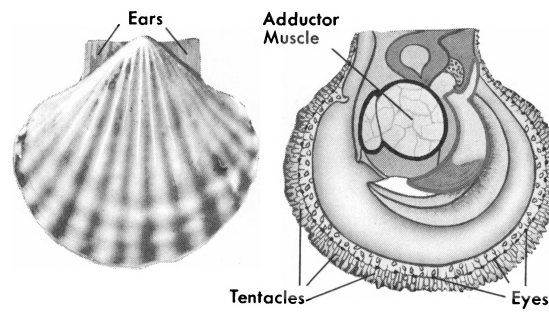
Several species of scallops live along the Atlantic and Pacific North American coasts. The most important is the common bay scallop, found in inlets from Massachusetts to the Gulf of Mexico. The deep-sea scallop may grow to be 8 inches (20 centimeters) in width. It is found from Labrador to North Carolina and especially off Maine and Nova Scotia. Fishermen catch deep-sea scallops at depths of 30 to 90 feet (9 to 27 meters) by dragging chain bags over the ocean bottoms.

The large adductor muscle is the only part of the scallop sold for food. The tender meat tastes somewhat like lobster meat, and is considered a delicacy.

Scallop shells have been used widely in designs. In the Middle Ages (about A.D. 400 to 1400) persons wore scallop shells on their hats to show they were on a *pilgrimage* (journey to a holy place).

Scientific Classification. Scallops belong to the clam and oyster class, *Pelecypoda* of the phylum *Mollusca.* The common bay scallop of North America is genus *Aequipecten,* species *A. irradians.* R. TUCKER ABBOTT

See also SHELL (color picture).



The Scallop has a hard shell, *left.* Tentacles and eyes edge the inner lining, *right.* The edible muscle is outlined in black.

SCALP is the covering of the skull on which the hair grows. It is formed by the thickest skin of the body. There are layers of fat and connective tissues and many blood vessels under the skin. The scalp muscles, located at the front and back of the skull, are connected by a cap of connective tissue over the top of the skull. When Indians scalped victims, they cut off this loose cap of tissue and its covering skin. The bones of the skull are nourished from below, so they do not die when the scalp is removed. Many persons lived for years after being scalped. Infections which develop between the connective tissues and the skull are difficult to control, and this area of the scalp is often called the "danger zone." See also DANDRUFF; HAIR. WILLIAM V. MAYER

SCALPEL. See SURGERY (Instruments); KNIFE.

SCAMMONY, *SKAM uh nee*, is a twining, climbing plant which comes from Asia Minor. It has white flowers and thick fleshy roots that are usually 2 to 3 feet (61 to 91 centimeters) long. A white, milky juice is taken from the roots. This juice is dried and hardened to form a gum resin used in medicine. It is used in laxatives, because the resin is a powerful cathartic.

Scientific Classification. The scammony belongs to the morning-glory family, *Convolvulaceae*. It is genus *Convolvulus*, species *C. scammonia*. HAROLD NORMAN MOLDENKE

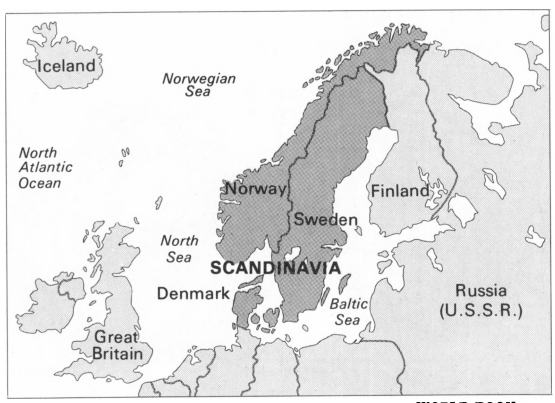
SCANDINAVIA, *SKAN duh NAY vih uh*, is the name often given to the peninsula of Norway and Sweden. But the term Scandinavia really refers to the countries where Scandinavian people live. This includes Denmark, Norway, and Sweden. These three countries together with Finland and Iceland form *Norden*. The countries belonging to Norden are often mistakenly referred to as Scandinavia.

Fennoscandia is a term that is often used to describe Finland and the Scandinavian Peninsula. Many regions near the Baltic Sea are known as *Baltoscandia*, because their climate and customs are much like those of the Scandinavian countries. Southern Sweden is called *Skåne*, or *Scania*, an ancient Roman word for a legendary island north of the Baltic Sea. RICHARD BECK

See also DENMARK; NORWAY; SWEDEN.

SCANDINAVIAN AIRLINES. See AIRLINE.

SCANDINAVIAN LITERATURE is rich in folk tales. Its history dates back almost a thousand years to the time of the *sagas* (heroic tales) and the two *Eddas*, in prose and verse, from Norway and Iceland. Among the most important of the sagas was the *Volsunga Saga*, the story of the Norse gods and heroes. Ancient poets, called *skalds*, were usually well educated, and composed poems about princes, warriors, and heroes. There were skalds in Norway as early as the 800's. From the time of the sagas to the 1700's, little outstanding literary work appeared in Scandinavia. The best-known figures of recent Scandinavian literature include the great dramatist Henrik Ibsen, the critic Georg Brandes, the poet Bjørnstjerne Bjørnson, and such winners of Nobel prizes for literature as Pär Fabian Lagerkvist, Selma Lagerlöf, Halldór Laxness, Knut Hamsun, and Sigrid Undset. RICHARD BECK



WORLD BOOK map

Location of Scandinavia

Related Articles. See the Arts section of the DENMARK; NORWAY; and SWEDEN articles. Other related articles in WORLD BOOK include:

Andersen, Hans C.
Asbjørnsen, Peter C.
Bjørnson, Bjørnstjerne
Dinesen, Isak
Edda
Hamsun, Knut
Holberg, Ludvig
Ibsen, Henrik
Jensen, Johannes V.
Lagerkvist, Pär F.
Lagerlöf, Selma
Laxness, Halldór K.
Mythology (Teutonic)
Pontoppidan, Henrik
Rölvaag, Ole E.
Saga
Sigurd
Skald
Snorri Sturluson
Strindberg, August
Undset, Sigrid
Wergeland, Henrik A.

SCANDIUM (chemical symbol, Sc), is a soft, silvery-white metal. Its atomic number is 21, and its atomic weight is 44.956. In 1869, Dmitri Mendeleev of Russia predicted its discovery, and described its properties. In 1879, Lars Nilson of Sweden discovered the element. He named it *scandium* after Scandinavia. Scandium occurs mainly in the minerals thortveitite and wiikite, but some occurs in tin and tungsten ores. Scandium forms colorless salts, melts at 1539° C (2802° F.), and boils at 2832° C (5130° F.). Spectrographic observations show that some stars contain much scandium. See also ELEMENT, CHEMICAL (table). FRANK H. SPEDDING

SCANNING. See TELEVISION (How Television Works); READING (Survey Reading); POETRY (Scansion).

SCAPA FLOW, *SKAP uh*, is a sea basin surrounded by the Orkney Islands off the north coast of Scotland. It is about 15 miles (24 kilometers) long and 8 miles (13 kilometers) wide. Scapa Flow became the headquarters of the battleship squadrons of the British Grand Fleet during World War I. On June 21, 1919, the defeated German navy scuttled its remaining ships in the basin. In World War II, a German submarine sank the British battleship *Royal Oak* in Scapa Flow. For location, see GREAT BRITAIN (physical map). See also ORKNEY ISLANDS. JOHN D. ISAACS

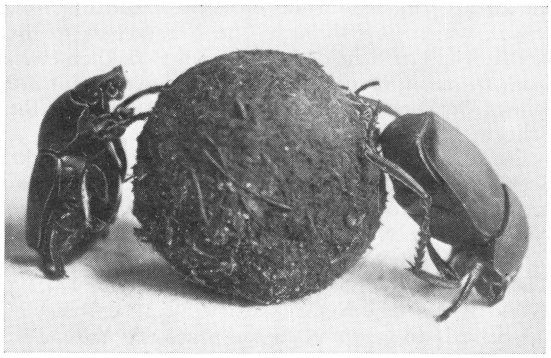
SCAPEGOAT, *SKAYP goht*, originally meant one of the two goats received by the Jewish high priest in ancient Jerusalem on the Day of Atonement. One was for Jehovah, the Hebrew God, and was killed as a sacrificial offering. The second was called the scapegoat. This one was for *Azazel*, which may have been the spirit of evil. The priest laid his hands upon the scapegoat as he confessed the people's sins. Then the priest sent the scapegoat into the wilderness. This was a symbol that the sins had been put away, or forgiven.

Today, when someone refers to a person as a scapegoat, it means he has been made to take the blame for something which is the fault of another. LOUIS L. MANN

SCAPHOPODA. See SHELL (Kinds of Mollusk Shells).

SCAPULA, in anatomy. See SKELETON.

SCARAB, *SKAR ub*, is a beetle once held sacred by the ancient Egyptians. Scarabs are dung beetles. Like some other dung beetles, they have the peculiar habit of breeding in dung. They sometimes roll this dung into small pellets, which they roll to their underground burrows to be used as larval food. Eggs are laid in the pellets. Egyptians regarded the pellets as symbols of the world, and believed that projections on the heads of the beetles were emblems of the rays of the sun. For the Egyptians, the scarab also symbolized the resurrection and immortality. They carved figures of the insects out of stone or metal, and used them as charms. Such figures were called scarabs. Usually, Egyptians removed the heart of a dead person, and put a large carved scarab in its place when the body was embalmed. Many of these scarabs were jeweled.



Cornelia Clarke

Two Scarabs With a Ball of Dung. The scarab on the right pushes the ball with its hind legs. Sometimes, another scarab tries to steal the ball by pulling it with its front legs, *left*.

Scientific Classification. The scarab belongs to the scarab family, *Scarabaeidae*. It is classified as genus *Scarabaeus*, species *S. sacer*. H. H. ROSS

SCARCITY. See RATIONING; VALUE.

SCARIFICATION. See TATTOOING.

SCARLATINA. See SCARLET FEVER.

SCARLATTI, *skahr LAHT ee*, is the family name of two Italian composers, father and son.

Alessandro Scarlatti (1659-1725), a leading composer of early Italian opera, achieved his greatest success with such works as *La Rosaura*, *Telemaco*, and *Griselda*. These operas stood on a high musical level and influenced composers in other countries, but they were less interesting from a dramatic point of view. His operas had overtures, called *sinfonia*, which usually consisted of a fast, a slow, and second fast movement. This form became of great significance in the development of the later orchestral symphony.

Scarlatti's fertility of mind was staggering. He wrote no less than 115 operas, 150 oratorios, and more than 600 cantatas, as well as instrumental compositions. He was born in Palermo, Sicily. As a young man, he lived in Rome as court composer of the former Swedish queen, Christina. He later moved to Naples.

Domenico Scarlatti (1685-1757) was the son of Alessandro Scarlatti. As a composer, he is nearly as famous as his father. He wrote vocal compositions, but became best known for his clavier sonatas. He wrote more than 550 of these bold and imaginative pieces, which display a great variety of expression.

Scarlatti was born in Naples in the same year as George Frideric Handel and Johann Sebastian Bach. He studied music with his father and became a harpsichord player. He taught the Portuguese princesses, and later moved to Madrid when one of them became Queen of Spain. When he was 69, he returned to Naples, where he died. KARL GEIRINGER

SCARLET FEVER, sometimes called *scarlatina*, is an infectious disease that chiefly affects children. It is named for the scarlet skin rash that develops. Because of increased knowledge of its cause and treatment, doctors no longer regard it as a grave disease.

Cause and Spread. A variety of bacteria called *hemolytic streptococci* cause scarlet fever (see STREPTOCOCCUS). They also cause tonsillitis and septic sore throat. Physicians often group all these diseases together and call them scarlet fever and related diseases. A person with a streptococcal infection may spread scarlet fever even though he has no sign of the disease himself. For example, a person with a sore throat, who coughs and sneezes without covering his nose and mouth, may spread the germs to a child. The child may develop a rash and other symptoms of scarlet fever.

Symptoms. The illness develops rapidly, with high fever, rapid pulse, nausea, headache, muscle pain, and general distress. The rash appears about a day after these first symptoms. It consists of red spots that become most pronounced about 48 hours after they first appear. Then they begin to fade. When the rash disappears, the skin starts to peel. If the rash has been extensive, the peeling will also be extensive. *Toxins*, or poisons, given off by the germs cause the rash and the peeling. The toxins may affect other organs. Sometimes they damage the heart and kidneys. A few patients develop other infections such as pneumonia, meningitis, and infections of the middle ear and lymph glands. Scarlet fever is most serious in children less than one year old. But as children grow older, they develop more resistance. Doctors believe that the greatest danger of scarlet fever and its related diseases is that they seem to precede rheumatic fever (see RHEUMATIC FEVER).

Treatment. Because scarlet fever is an infectious disease, patients should be kept apart from other persons. This helps keep the disease from spreading. The room should be quiet and well ventilated. The patient should cover his nose and mouth whenever he coughs or sneezes. Paper tissues are best for this purpose because they can be burned after use. All discharges from the patient's ears, nose, and throat should be destroyed. Bedding and clothing should be thoroughly disinfected.

Doctors prescribe measures that control the patient's fever and make him comfortable. The physician often gives penicillin, which is particularly effective against these germs. But he may give other drugs as well. Sometimes he injects an *antitoxin* to neutralize the poison given off by the germs. But often this is given only in severe cases. The antitoxin used was developed by George F. and Gladys H. Dick, pioneer investigators of infections caused by streptococcal germs. They injected small amounts of scarlet fever toxin into a horse's blood and derived an antitoxin from the animal's blood

serum (see ANTITOXIN). The Dicks also developed a skin test designed to show sensitivity to scarlet fever. See also DISEASE (tables). H. WORLEY KENDELL

SCARLET HAW. See HAWTHORN.

SCARLET LETTER, THE. See HAWTHORNE, NATHANIEL.

SCARLET TANAGER. See TANAGER.

SCENERY. See THEATER (Scene Design); STAGE DESIGNER; BALLET (Scenery and Costumes).

SCHACHT, *shahkt,* **HJALMAR** (1877-1970), was a German financial statesman. As Adolf Hitler's minister of economics, he devised ways to finance Germany's preparations for World War II. He resigned his position in 1937 after disagreeing with Nazi economic and foreign policies. Schacht remained in the government as a minister until 1942. He took part in plots to assassinate Hitler. Schacht was acquitted at the Nuremberg trials (see NUREMBERG TRIALS). He became a banker after the war and advised Asian and African governments.

He was born in Tingleff, Germany (now Tinglev, Denmark) and was a brilliant student at Kiel University. He made banking his career, and received an important position with the Bank of Dresden. He eventually became head of the Reichsbank, Germany's central bank, in 1924. After World War I, Schacht represented Germany on the commissions which settled German war reparations. DONALD L. KEMMERER

SCHECHTER V. UNITED STATES was a case in which the Supreme Court of the United States ruled that the National Industrial Recovery Act (NIRA) of 1933 was unconstitutional. The NIRA, a basic part of President Franklin D. Roosevelt's New Deal, empowered the President to set up codes of fair competition for businesses and industries. It was based on the federal government's constitutional power to regulate *interstate commerce* (trade between states). The Schechter Poultry Corporation of New York City was convicted of violating an NIRA code. The Supreme Court found the NIRA unconstitutional because it excessively delegated legislative power to the President, and it involved the federal government in regulating *intrastate commerce* (trade wholly within a state). STANLEY I. KUTLER

See NATIONAL RECOVERY ADMINISTRATION.

SCHEELE, *SHAY luh,* **CARL WILHELM** (1742-1786), was the Swedish pharmacist-chemist who discovered chlorine. He also prepared oxygen. But he did not publish his work in time, and Joseph Priestley, an English scientist, received credit.

In 1770, Scheele discovered tartaric acid. He was also the first to obtain pure lactic, oxalic, citric, and hydrofluoric acids. He discovered Scheele's green (copper arsenite), molybdenum, and scheelite (calcium tungstate). Scheele was born in Stralsund, Germany, and as a boy became a pharmacist's assistant. He later opened his own pharmacy shop in Köping, Sweden, and made most of his discoveries there. K. L. KAUFMAN

See also CHLORINE; CHEMISTRY (The Discovery of Oxygen); MOLYBDENUM.

SCHEELITE. See SCHEELE, CARL WILHELM; TUNGSTEN.

SCHEHERAZADE, *shuh HEHR uh ZAH duh,* was the legendary queen who told the stories in the *Arabian Nights.* According to the legend, she married the Sultan Shahriyar of Persia, who made a practice of strangling his wives the morning after each wedding. But he spared Scheherazade because she entertained him with her stories. See also ALADDIN; ARABIAN NIGHTS; RIMSKY-KORSAKOV, NICHOLAS. ARTHUR M. SELVI

SCHELDE RIVER, *SKEHL duh,* is one of the most important commercial waterways of Europe, and is especially important to Belgium. It rises in the northern part of France (where it is called the Escaut), southeast of the city of Lille. From there, the river flows in a northeasterly direction through Belgium. For location, see BELGIUM (color map). In Antwerp, Belgium, the river separates into the *East Schelde* and the *West Schelde,* which flow through The Netherlands to the North Sea. The Schelde is 270 miles (435 kilometers) long. By means of locks, boats can sail over about 210 miles (338 kilometers) of its course. Canals link the Schelde, Meuse, and Rhine rivers.

For 200 years, the Dutch held the right to close the Schelde to water traffic. When Belgium and The Netherlands drew up the Treaty of London of 1839, The Netherlands received permission to charge a *toll* (tax) for the use of the Schelde River by commercial vessels. These tolls were finally abolished in 1863. During World War I, The Netherlands closed the entrance of the Schelde to warships. In the peace negotiations in 1919, Belgium tried unsuccessfully to gain Dutch territory along the Schelde for full control of the river.

During the German invasion of Belgium and of The Netherlands in 1940, and during the German retreat in 1944, heavy fighting occurred along the Schelde and the Albert Canal. The canal connects the Meuse and the Schelde rivers. DANIEL H. THOMAS

SCHELLING, *SHEHL ihng,* **FRIEDRICH WILHELM JOSEPH VON** (1775-1854), was a German philosopher. His earlier works are generally understood as an important link between Immanuel Kant and Johann Gottlieb Fichte on the one hand, and G. W. F. Hegel on the other. These works are representative of German idealism and romanticism. Schelling's *System of Transcendental Idealism* (1800) was the major work of his youth. He later criticized his own early works and Hegel's philosophy as "negative philosophy." Schelling attempted to develop a "positive philosophy" which stressed revelation and influenced existentialism (see EXISTENTIALISM).

Schelling was born in Leonberg, near Stuttgart, Germany. He entered the Tübingen theological seminary at 16, and became a friend of G. W. F. Hegel and Friedrich Hölderlin. In the preface to his first book, Hegel criticized Schelling, though not by name, and Schelling never forgave him. Soon Hegel's influence far exceeded Schelling's. WALTER KAUFMANN

SCHENECTADY, *skuh NEHK tuh dih,* N.Y. (pop. 77,958), is sometimes called the *City that Lights and Hauls the World* because it has a huge electrical-manufacturing industry and an important locomotive concern. The city is also known as the *City of Magic* because of the important scientific work performed at the research laboratory of the General Electric Company. This is the largest industrial establishment in the state (see GENERAL ELECTRIC COMPANY). Factories in the city make gloves, chemical products, and cement products.

Schenectady is an Indian name meaning *end of trail.* The city received its name because it lay at the meeting point of Indian trails from the north, south, and east.

Location, Size, and Description. Schenectady lies in east-central New York, about 15 miles (24 kilometers) northwest of Albany, and about 160 miles (257 kilometers) northwest of New York City. It forms a metropolitan area of 777,977 persons with nearby Albany and Troy. Schenectady faces mountain ranges on three sides. The Adirondacks are on the north. The Green Mountains and the Berkshire Hills lie on the east. On the south are the Helderberg and Catskill mountains. The Mohawk River flows eastward along the northern limits of the city. In the early days of Indian and pioneer life, Schenectady shared this river's reputation as the *Gateway to the West*. See NEW YORK (political map).

Cultural Life and Recreation. Schenectady is the home of Union College, one of the oldest colleges in the United States, founded in 1795. The city is the site of Schenectady County Historical Society and the Schenectady Museum. Dutch homesteads still stand in some sections of the city. There are 12 parks and 25 recreation areas.

History. Arendt van Curler and 14 other Dutch pioneers purchased the site of the city in 1661. The Indians gave up all their claims to this land. Several years later, they received in exchange belts of white wampum, six coats, 20 barrels of lead, and nine bags of gunpowder. The English took possession of Schenectady in 1664. In 1690, the settlement suffered from a terrible French and Indian massacre. It was rebuilt and became an important trading post. Schenectady received its borough charter in 1765, and became a city in 1798. It has a council-manager government. WILLIAM E. YOUNG

SCHENK, ARD. See OLYMPIC GAMES (table: Speed Skating).

SCHERZO, *SKEHR tso*, is a musical term usually applied to the liveliest and happiest movement of a sonata, symphony, or string quartet. The term may also be used for a separate instrumental composition. A scherzo is characterized by marked rhythmic figures and frequent repetitions of themes. The word *scherzo* is Italian, meaning *jest* or *joke*.

SCHEVENINGEN. See HAGUE, THE.

SCHICK, *shik*, **BÉLA** (1877-1967), was an authority on the diseases of childhood. He became best known for a skin test, developed in 1913, for determining whether or not a person is likely to catch diphtheria (see DIPHTHERIA; SCHICK TEST). He also did important research on such children's diseases as scarlet fever, serum sickness, tuberculosis, and infantile diarrhea.

Schick worked in Vienna with Theodor Escherich and Clemens von Pirquet, and became an authority on scarlet fever. With Von Pirquet, he laid the foundation of our knowledge of serum sickness and allergy. He came to the United States in 1923. Schick was born in Boglár, Hungary. HENRY J. L. MARRIOTT

SCHICK TEST is a test for diphtheria immunity. A very small amount of diphtheria toxin is injected under the skin. There is no effect if the person is immune to the disease, but the area around the injection becomes inflamed if he is not. Children with a positive reaction should receive injections to immunize them. Béla Schick introduced the test in 1913. See also DIPHTHERIA; SCHICK, BÉLA. PAUL S. RHOADS

SCHICKLGRUBER. See HITLER, ADOLF (Boyhood).

SCHILLER, JOHANN CHRISTOPH FRIEDRICH VON (1759-1805), ranks second only to Goethe among the leading figures of German literature, and no German compares to him as a playwright. Schiller was a master of dramatic construction and character portrayal. His dramas are pleas for human freedom and dignity. They inspired German liberals in their fight for liberty during the early 1800's and during the Revolution of 1848.

Friedrich Schiller was born in Marbach in the duchy of Württemberg. The duke of Württemberg made him attend a military academy where he studied medicine, but he left his post as an army surgeon in 1782 to devote himself to writing. Schiller's early plays protested against the tyranny of the German aristocracy. His first drama, *The Robbers* (1781), enjoyed sensational success. His other early plays include the political-historical dramas *Fiesco* (1783) and *Don Carlos* (1787), and the middle-class tragedy *Intrigue and Love* (1784).

The period between 1787 and 1796 formed a separate part of Schiller's career. Unsure of his abilities as a dramatist, he turned to historical writing with *The Revolt of The Netherlands* (1788), a work dealing with the same period as *Don Carlos;* and *The History of the Thirty Years' War* (1791-1793). Schiller's literary talents injected a vivid dramatic quality into these works. Schiller's writings in the early 1790's on philosophy and aesthetic theory gave him an important place in the development of German idealism. These writings also established him as the most important theorist of German classicism.

Schiller's friendship with Goethe from 1794 reawakened his interest in drama. His greatest drama, *Wallenstein* (1796-1799), is a tragedy set during the Thirty Years' War. It explores the relationship between a great individual and fate. The drama is a cycle of three parts, written in dignified blank verse. Three other historical plays followed. *Maria Stuart* (1800) deals with the life of the Scottish queen. *The Maid of Orleans* (1801) is the story of Joan of Arc. *William Tell* (1804), Schiller's most popular play, dramatizes Switzerland's struggle for freedom. *The Bride of Messina* (1803) is modeled on classical Greek drama.

Between 1785 and 1800, Schiller edited three literary magazines, to which he contributed many essays, lyrics, and stories. He became known for such philosophical lyrics as "The Song of the Bell." One of his most famous ballads is "The Diver." Two stories, "The Ghostseer" and "The Criminal from Lost Honor," rank among the first German short-story masterpieces. CORA LEE PRICE

See also GERMAN LITERATURE (The Storm and Stress Movement).

SCHILLING is the monetary unit of Austria. It is made up of 100 groschen. The schilling was first introduced in Austria in 1924. It was temporarily replaced by the German mark from 1938 to 1945. See MONEY (table).

SCHIPPERKE, *SKIP er kih*, is a dog of Belgium. It is also called the *Barge Dog* or *Little Skipper*, because it once guarded canal barges and hurried the horses that pulled them. The dog has a foxlike head with small, pointed ears. It has a heavy black coat with a long frill on its neck. Sometimes it is born without a tail. The dog weighs about 15 pounds (7 kilograms). See also DOG (picture: Nonsporting Dogs). JOSEPHINE Z. RINE

SCHIRRA, *shih RAH*, **WALTER MARTY, JR.** (1923-), served as a United States astronaut from 1959 to 1969. He was the first astronaut to fly in three different types of spacecraft—Mercury, Gemini, and Apollo.

SCHISM, GREAT

On Oct. 3, 1962, Schirra circled the earth six times in *Sigma 7*, a Mercury program spacecraft. He took part in the first space *rendezvous* (meeting) on Dec. 15, 1965, when he and Thomas P. Stafford guided Gemini 6 to within 1 foot (30 centimeters) of Gemini 7. Frank Borman and James A. Lovell, Jr., piloted Gemini 7. Schirra was the command pilot of Gemini 6, which circled the earth 16 times. He also commanded Apollo 7, the first U.S. spacecraft to carry three men. The Apollo 7 flight lasted from Oct. 11 to Oct. 22, 1968. It was part of the Apollo program, which later landed men on the moon. Schirra, R. Walter Cunningham, and Donn F. Eisele circled the earth 163 times during the flight.

Schirra was born in Hackensack, N.J., and learned to fly an airplane as a boy. His father was a World War I pilot and a stunt flier. His mother was also a stunt flier. Schirra graduated from the United States Naval Academy in 1945. He flew 90 combat missions during the Korean War (1950-1953) and became one of the seven original astronauts in 1959. Schirra retired from the astronaut program and the Navy in 1969 and entered private business. WILLIAM J. CROMIE

See also ASTRONAUT.

SCHISM, GREAT. See CHRISTIANITY (Heresies and Schisms); POPE (The Troubles of the Papacy); ROMAN CATHOLIC CHURCH (The Great Schism).

SCHIST. See ROCK (Metamorphic Rock).

SCHISTOSOMIASIS, *shihs tuh soh MY uh sihs*, is a disease caused by flatworms called *schistosomes*. Many health authorities believe schistosomiasis ranks second only to malaria among disabling tropical diseases. Schistosomiasis afflicts more than 200 million persons in areas of Africa, Asia, and Latin America. It chiefly infects rural people who use contaminated water for bathing, laundering, and waste disposal.

The larvae of schistosomes enter the body of a human being or animal through the skin. These microscopic larvae live in the blood as parasites. Schistosomiasis results from an accumulation of eggs laid by adult schistosomes. In time, the eggs interfere with the flow of blood, cause infection, and destroy tissues of the kidneys, liver, lungs, and other organs. Through the years, schistosomiasis can weaken the victim and reduce his energy and ability to work. It can also cause death after a number of years.

Some schistosome eggs leave the victim through body wastes. After reaching fresh water, the eggs hatch into the larvae, called *miracidia*. The miracidia swim about until they contact certain species of snails that serve as *hosts* (organisms in which parasites live). These larvae develop into another form of schistosome larvae called *cercariae*. The cercariae leave the snail host and swim about seeking another host. Cercariae burrow into the skin of human beings or animals that swim or wade in contaminated water. The larvae invade the blood stream, where they mature into adult schistosomes.

Treatment of schistosomiasis involves the use of strong drugs that may produce such reactions as nausea, vomiting, rapid pulse, and low blood pressure. The drugs can cause death in some cases. Governments and health organizations try to control the disease by providing a clean water supply, improving sanitation methods, and killing the host snails.

Schistosomiasis is also called *bilharziasis*. It was first identified in 1851 by Theodor Bilharz, a German physician. THOMAS H. WELLER

See also FLATWORM; FLUKE.

SCHIZOMYCETE, *SKIHZ oh my SEET*, is the name of a group of primitive plant organisms without chlorophyll.

SCHIZOPHRENIA. See MENTAL ILLNESS (Kinds).

SCHLEICHER, AUGUST. See LINGUISTICS (The Comparativists).

SCHLEIDEN, MATTHIAS. See BIOLOGY (The 1800's).

SCHLESINGER, *SHLAY zihng ur*, is the family name of two American historians, father and son.

Arthur Meier Schlesinger (1888-1965) became known as the dean of American historians. As a teacher and author, he was a leader in interpreting American history in its economic, social, and cultural aspects in such books as *The Colonial Merchants and the American Revolution* (1918), *The Rise of the City* (1933), and *Prelude to Independence* (1957). He described trends in the manners and morals of America in *Learning How to Behave* (1946) and other works. He also emphasized the importance of the growth of cities in American history. Schlesinger was born in Xenia, Ohio. He taught U.S. history at Harvard University from 1924 to 1954.

Arthur Meier Schlesinger, Jr. (1917-), won two Pulitzer prizes. In 1946, he won the history award for *The Age of Jackson*. In 1966, his *A Thousand Days: John F. Kennedy in the White House* won the Pulitzer prize for biography. *The Age of Roosevelt*, Schlesinger's three-volume biography of Franklin D. Roosevelt, was published in 1957, 1959, and 1960. Schlesinger taught at Harvard University from 1947 to 1961. From 1961 to 1964, he served as a special assistant to Presidents John F. Kennedy and Lyndon B. Johnson. In 1966, Schlesinger became a faculty member at City University of New York. He was born in Columbus, Ohio. MERLE CURTI

Wide World

Arthur Schlesinger, Jr.

SCHLESINGER, JAMES RODNEY (1929-), became secretary of defense under President Richard M. Nixon in July, 1973. Schlesinger favored the limited use in wartime of nuclear weapons against military targets. He also supported a broad program of research and development for the Department of Defense.

From 1967 to 1969, Schlesinger worked on nuclear weapons strategy as director of strategic studies for the Rand Corporation. He became assistant director of the Bureau of the Budget in 1969. Following a reorganization of that agency, Schlesinger served as assistant director of the new Office of Management and Budget. Nixon appointed him chairman of the Atomic Energy Commission in 1971. In February, 1973, Schlesinger became director of the Central Intelligence Agency.

Schlesinger was born in New York City and earned B.A., M.A., and Ph.D. degrees at Harvard University. He taught economics at the University of Virginia from 1955 to 1963, when he joined the staff of the Rand Corporation. GUY HALVERSON

SCHLESWIG-HOLSTEIN, *SHLEHS wihg HOHL styn,* or *SHLAYS vihk HAWL shtyn,* is a state in West Germany. It lies south of Denmark, in the southern part of the peninsula separating the North and Baltic seas.

Schleswig-Holstein covers 6,052 square miles (15,675 square kilometers), and has 2,557,200 people. The Eider River divides Schleswig from Holstein. The state's chief city is the seaport Kiel (see KIEL). Most people are farmers. Dairying is a chief industry.

Schleswig and Holstein have belonged at various times to Denmark and to Germany. Prussia took control of them in 1866. After World War I, the northern part of Schleswig united with Denmark. The rest of the state became a part of Germany. JAMES K. POLLOCK

See also DENMARK (History); SEVEN WEEKS' WAR.

SCHLEY, *sly,* **WINFIELD SCOTT** (1839-1911), an American naval officer, commanded the expedition that rescued the Arctic explorer Adolphus W. Greely in 1884. With James Russell Soley, he published the book *The Rescue of Greely* in 1885. Schley also commanded the American naval forces at the battle of Santiago in 1898, and became involved in a famous dispute with Rear Admiral William Sampson over credit for the victory (see SAMPSON, WILLIAM THOMAS). Schley was born in Frederick County, Maryland. DONALD W. MITCHELL

SCHLEYER, JOHANN MARTIN. See VOLAPÜK.

SCHLIEFFEN PLAN, *SHLEE fuhn,* formed the basis for Germany's strategy to meet threats of war with Russia in the east and France in the west at the same time. The plan was devised between 1895 and 1905 by General Alfred von Schlieffen, chief of the German general staff, after France and Russia allied against Germany.

Schlieffen believed Germany must defeat France before Russia could fully mobilize for war. The entire German Army would march swiftly through neutral Belgium and The Netherlands and destroy the French army. Then it would move east to face the Russians.

When World War I began, however, a modified form of this plan failed. Some German forces were left to defend Alsace-Lorraine, and others went to the Russian front. The rest marched through Belgium, but were met by Belgian, French, and British forces. This shattered German hopes for a quick victory. GEORGE G. WINDELL

SCHLIEMANN, *SHLEE mahn,* **HEINRICH** (1822-1890), a German businessman, became famous as an archaeologist. He discovered and excavated the ruins of ancient Troy and other buried cities mentioned in Homer's *Iliad* (see TROY). These discoveries were important to knowledge of early Greek civilization.

Schliemann's extensive business dealings in Russia during the Crimean War helped make him a wealthy man. He retired in the 1860's, and spent the rest of his life directing the excavation of ancient cities along the eastern Mediterranean Sea. Schliemann was born at Neu-Buckow, in Mecklenburg-Schwerin, of a poor family. He received little formal education. Schliemann became a United States citizen in 1869. DAVID B. STOUT

See also AEGEAN CIVILIZATION.

SCHMALKALDIC LEAGUE, *shmahl KAHL dihk,* was an alliance formed by the early German Protestants to defend themselves against Emperor Charles V and the Roman Catholic states. The league was formed in 1531, and the War of the Schmalkaldic League followed. The Protestants were defeated in 1547. But the league's aims were partly realized five years later in the Treaty of Passau. Charles V agreed to a temporary peace until a conference could settle matters. The conference, known as the Peace of Augsburg, took place in 1555. Under its terms, both Roman Catholic and Lutheran churches were legally permitted for the first time in Western Europe. See also REFORMATION. J. SALWYN SCHAPIRO

SCHMIDT, HELMUT (1918-), became chancellor of West Germany in 1974. Schmidt succeeded Willy Brandt, under whom he had served as minister of defense, minister of economics, and minister of finance and economics.

As chancellor, Schmidt became known for his skillful management of economic affairs. He also promoted economic cooperation among Western European nations and maintained close ties between West Germany and the United States.

United Press Int.

Helmut Schmidt

Helmut Heinrich Waldemar Schmidt was born in Hamburg, in what is now West Germany. He served in the German Army during World War II (1939-1945). Schmidt joined the Social Democratic Party in 1946 and was chairman of West Germany's socialist student association during the late 1940's. He graduated from the University of Hamburg in 1949.

Schmidt served in the *Bundestag* (lower house of parliament) from 1953 to 1962, when he became a government official in Hamburg. He was again elected to the Bundestag in 1965. MELVIN CROAN

SCHMIDT TELESCOPE. See HALE OBSERVATORIES; TELESCOPE.

SCHMITT, HARRISON HAGAN (1935-), was the first United States scientist-astronaut to fly in space. In December, 1972, during the Apollo 17 mission, he and astronaut Eugene A. Cernan made man's longest lunar visit—75 hours on the moon. Schmitt, a geologist, studied the surface and selected rocks for later study.

Schmitt, who is known by the nickname Jack, was born in Santa Rita, N. Mex. He graduated from the California Institute of Technology in 1957 and earned a Ph.D. from Harvard University in 1964. From 1964 to 1965, Schmitt assisted the U.S. Geological Survey in mapping the moon and the planets. He became an astronaut in 1965 and taught lunar geology to other astronauts during the late 1960's. WILLIAM J. CROMIE

SCHMITZ, JOHN G. See AMERICAN INDEPENDENT PARTY.

SCHNAUZER, *SHNOW zuhr,* is the name of three breeds of German dogs. These breeds are based on size. The *miniature* schnauzer is about 12 inches (30 centimeters) high, the *standard* is 18 to 20 inches (46 to 51 centimeters) high, and the *giant* is 21 to 25 inches (53 to 64 centimeters) high. All have a shaggy muzzle and shaggy eyebrows, like the airedale. OLGA DAKAN

See also DOG (pictures: Working Dogs, Terriers); GIANT SCHNAUZER.

SCHNITZER, EDUARD. See EMIN PASHA.

SCHNITZLER, ARTHUR (1862-1931), was an Austrian writer whose works reflect the influence of Sigmund Freud's psychoanalytical teachings. Many of Schnitzler's plays and stories deal with middle-class and aristocratic society in Vienna, showing their liberal attitudes and double standards of morality. Schnitzler was a master of characterization and he was fond of his fellow Viennese. But he exposed their weaknesses and shortcomings through subtle psychological probing.

Two main themes appear in Schnitzler's work: love, and the question of what reality actually is. Both appear in his plays *Anatol* (1893), concerning a young man's adventures in love; and *La Ronde* (1900), a cycle of love affairs involving different groups in society. Schnitzler's best-known story is the short novel *Leutnant Gustl* (1901). He was born in Vienna. WALTHER L. HAHN

SCHOENBRUNN VILLAGE. See OHIO (Places to Visit).

SCHOFIELD, *SKOH feeld,* **JOHN McALLISTER** (1831-1906), commanded the Union forces that captured Wilmington, N.C., during the Civil War. He also successfully defended Franklin, Tenn., in 1864. He was born in Chautauqua County, New York, and was graduated from the United States Military Academy at West Point. After the war he served as secretary of war, and from 1888 to 1895 as U.S. Army commanding general. H. A. DE WEERD

SCHOFIELD BARRACKS, Hawaii, is the largest United States Army outpost outside the continental United States. It houses combat units of the United States Army, Hawaii. The command also includes Tripler General Army Hospital, on the slopes of the Koolau Mountains; and the National Memorial Cemetery of the Pacific, which lies within Punchbowl Crater. The post lies 28 miles (45 kilometers) north of Honolulu and covers 14,219 acres (5,754 hectares). It was set up in 1908 and named for Civil War General John M. Schofield. SAMUEL J. ZISKIND

SCHOHARIE RESERVOIR. See CATSKILL MOUNTAINS.

SCHOLARSHIP is a grant of money or free tuition awarded to a student on the basis of achievement, ability, or financial need. People usually consider a scholarship an honor in recognition of outstanding academic work, as well as financial aid to those who need it. Scholarships are generally awarded as a means of selecting and training capable young persons so that they may become assets to the community and nation.

Endowed foundations and government agencies often grant funds for advanced study and for research. Such grants are called *fellowships.* Universities and colleges grant *scholarships* for undergraduate study. More and more businesses, industries, labor unions, and government sources provide thousands of scholarships each year for general education or for special fields of study. See FELLOWSHIP; FOUNDATIONS (Education).

In the mid-1930's, educators estimated that about 72,000 scholarships and fellowships were available in the United States. They totaled in value about $11 million. The number of scholarships has increased to an estimated 300,000 with a total value of about $98 million. Most individual undergraduate scholarships range in value from $100 to $1,500 a year. They average about $340 a year. In 1965, Congress passed the Higher Education Act. The act includes provisions for cash grants to university and college students. The grants are called "Education Opportunity Grants."

Private Colleges and Universities establish scholarships to attract students of outstanding intellectual ability or academic achievement. Scholarships also help promote particular fields of study, such as science, humanities, engineering, and nursing. Many scholarships are founded for personal reasons, and carry the name of the donor.

State Scholarships are available in various forms for persons with special abilities, disabilities, or needs. State colleges and universities grant fewer scholarships than private institutions, because they have lower tuitions. Nevertheless, many states establish *legislative scholarships* for students from various regions of the state or for out-of-state residents. Many states also provide special scholarship aid for students with various types of disabilities, through their vocational rehabilitation programs.

National Merit Scholarships were established in 1955, and quickly became the largest independently supported scholarship program in the country. The National Merit Scholarship Corporation, of Evanston, Ill., administers this program. The Ford Foundation gave $20 million and the Carnegie Corporation gave $500,000 to establish the program. Additional grants from the Ford Foundation, and from other foundations, corporations, colleges, and other sources had provided over $78 million in scholarships by the early 1970's.

About 3,300 merit scholars are chosen each year from about 750,000 high school seniors throughout the country who have taken the examinations. Students take the examinations in their junior year. Final selections are made by a board of experts and business sponsors. The board considers students' test scores, records, participation in school and community activities, character, leadership, financial needs, and recommendations of the high schools. The number of scholarships in each state is based roughly on the number of high-school seniors in the state.

Grants to Veterans. Federal grants were given to veterans of World War II for study in any approved college, university, or vocational or trade school under the amended Servicemen's Readjustment Act, often called the *GI Bill of Rights.* To be eligible, veterans must have had at least 90 days of service and an honorable discharge. Grants were available for a period up to four years, depending on the length of service. The veteran received a monthly maintenance allowance, but the government paid the tuition and fees directly to the institution. Similar grants were made to veterans who served in the Korean War or afterwards, and who were not covered by other bills. The government sent monthly payments for maintenance and fees directly to the veterans. The veterans paid the fees themselves. By the early 1970's, about 13 million men and women received educational benefits amounting to about $21 billion. See GI BILL OF RIGHTS.

International Scholarships. More than 110,000 students from other countries study in the United States every year, many on government or private scholarship funds. Organizations in the United States and in other countries also award a number of scholarships to send American students and teachers overseas. The purpose

of such scholarships is to promote better international understanding and cultural relations.

The oldest and most famous of the international scholarships are the *Rhodes scholarships* (see RHODES SCHOLARSHIP). The newest and most numerous are the *Fulbright scholarships*, supported by the federal government (see FULBRIGHT SCHOLARSHIP). The Fulbright awards provide a year's schooling in the United States for students from other countries, and a year of study abroad for U.S. students and teachers. The United States also exchanges several international scholarships with Latin-American countries. The U.S. clearing house for exchange scholarships and fellowships is the Institute of International Education in New York City. A growing number of colleges and universities offer scholarships to returning volunteers from Peace Corps or other government service. R. FREEMAN BUTTS

See also AMERICAN FIELD SERVICE; FELLOWSHIP.

SCHOLASTICISM was a philosophical system that emphasized the use of reason in exploring questions of philosophy and theology. The Scholastics particularly tried to prove the truth of Christian doctrine. They also tried to reconcile contradictory viewpoints in Christian theology. Scholasticism had its greatest influence from the 1000's to the 1400's, especially during the 1200's. Most Scholastics taught in the schools and universities of western Europe.

The Scholastic Method. The Scholastics developed an extremely formal and sophisticated procedure of investigating philosophical and theological questions. Their method became known as the *disputed question.*

The disputed question started with a problem stated by the teacher. His students then listed the arguments for and against a certain solution to the problem. Next, the students took a position on the problem. Finally, they dealt, one by one, with the arguments on all sides of the problem. Using this method, the teacher and students tried to reach a balanced solution.

Scholastics analyzed philosophical and theological questions in books called *books of sentences.* A book of sentences contained quotations or summaries of dogma compiled from the Bible and from works by early Christian writers. If the quotations or summaries conflicted, the compiler tried to reconcile the conflicts by his own commentaries based on reason. The *Four Books of Sentences* (mid-1100's) by Peter Lombard became the standard theological textbook.

Scholasticism trained its followers to consider every side of a question logically and rationally. It also trained them to state their arguments briefly and clearly. However, critics claimed that scholasticism relied so much on formal systems that it became artificial and inflexible. Critics also complained that the scholastic method led to the assumption that every problem could be solved by reasoning.

History. Scholasticism originated during the 1000's in schools operated by cathedrals and monasteries. The writings on logic by the ancient Greek philosopher Aristotle had an important early influence on scholasticism. Aristotle had used logic to try to prove the existence of God. His approach attracted many Scholastics, especially Peter Abelard.

Scholasticism reached its high point during the 1200's in western European universities. Many works by Aristotle that had been unknown to medieval philosophers were translated into Latin. For the first time, scholars could study a complete body of philosophy based on experience and reason alone. Until the translations of Aristotle's works, medieval philosophy had been based largely on the Bible and on writings by early Christian theologians. The Scholastics tried to reconcile Aristotle's philosophy with Christianity. They also applied his philosophy to theological problems.

The major Scholastics of the 1200's included Saint Albertus Magnus, Alexander of Hales, Saint Thomas Aquinas, Roger Bacon, Saint Bonaventure, and Robert Grosseteste. Aquinas, the most important Scholastic, developed a philosophy that claimed to lead through reason alone to basic truths about God and the soul. But Aquinas believed that man needs divine revelation to fill out and expand such knowledge.

In the 1300's, the Scholastics John Duns Scotus and William of Occam rejected Aquinas' emphasis on reason. They believed that God's actions and purposes are unpredictable and must be learned through revelation.

Beginning in the mid-1600's, scholasticism gradually lost its influence. Today, however, the teachings of some Roman Catholic theologians still reflect this influence. EUGENE TESELLE

Related Articles in WORLD BOOK include:

Abelard, Peter
Albertus Magnus, Saint
Anselm, Saint
Aquinas, Saint Thomas
Aristotle
Bacon, Roger
Bonaventure, Saint
Duns Scotus, John
Grosseteste, Robert
Lombard, Peter
Maritain, Jacques

SCHÖNBEIN, CHRISTIAN F. See GUNCOTTON; GEOCHEMISTRY; OZONE.

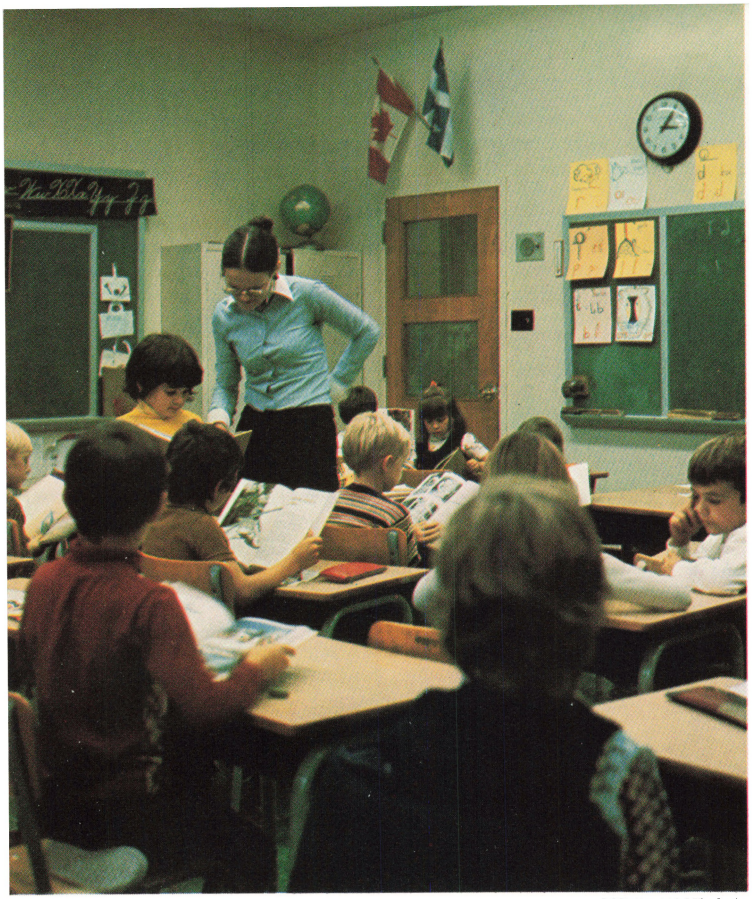
SCHÖNBERG, *SHOHN behrg*, **ARNOLD** (1874-1951), was one of the most revolutionary composers of the 1900's. At first strongly influenced by Richard Wagner, he gradually developed a style of writing which he called "the technique of composition with 12 tones." He derived his melodies and harmonies from an arrangement of all 12 chromatic tones. All are of equal importance, and there is no feeling of key. The technique, formulated about 1925, has influenced many composers.

Schönberg was born in Vienna and studied music there, but he mainly taught himself theory and composition. His association with the "expressionist" painters was influential in forming his musical style. Much of his music aroused hostility, especially *Pierrot Lunaire*, a group of 21 short melodramas for voice and instruments.

Schönberg taught in Berlin until he was ousted when Adolf Hitler came to power in 1933. Then he came to the United States, where he continued to teach. His best-known works include the string sextet, *Transfigured Night;* two chamber symphonies; and four string quartets. HALSEY STEVENS

See also BERG, ALBAN; BALLET (Music).

SCHONGAUER, *SHOHN gow ur*, **MARTIN** (1445?-1491), was a German painter and one of the first printmakers to engrave on copper. He was also the first painter-engraver, and greatly influenced Albrecht Dürer. The altarpiece, *Virgin and Child with Hedge of Roses*, is the only painting attributed to him with certainty. Of his 113 known prints, the *Death of the Virgin* is perhaps the best known. Schongauer was born in Colmar, Alsace (now in France). S. W. HAYTER



WORLD BOOK photo

Elementary School Classroom in Canada

Jim Collins

Open School Classroom in the United States

Jan Lönn from Carl Östman

Preschool Class in North Korea

The Great Variety of Schools throughout the world is shown by the photographs above and on the next page. All schools have the job of teaching people the skills needed in everyday life.

SCHOOL

SCHOOL is one of our most important institutions. Schools teach reading, writing, and other basic skills needed in everyday life. Schools increase people's knowledge of the world, train them for a job or career, and help them adjust to the rapid changes that take place in modern life. In schools, people learn their responsibilities as citizens and the importance of such values as truth and justice. Schools also help people learn to enjoy the arts and to develop other interests that make leisure time more rewarding.

People throughout the world attend school. But the quality of schools varies widely among countries. The industrialized nations—such as Australia, Canada, Japan, the United States, and most European nations—have well-developed educational systems. Most of their schools have skilled teachers, modern equipment, and a variety of educational materials. Most young people in these countries complete elementary school and enter secondary school. Many also continue on to college.

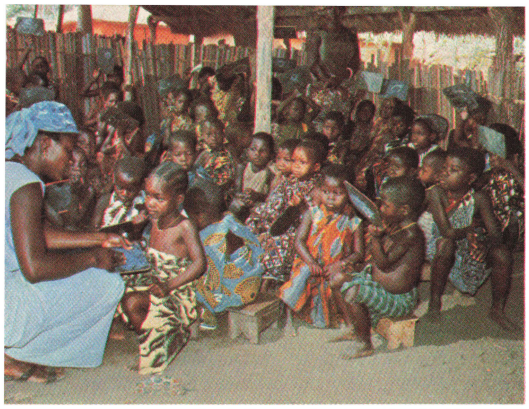
Other nations—especially the developing nations of Africa and Asia—cannot yet afford complete educational systems. Some areas of these countries do not even have schools. In other areas, the schools lack skilled teachers and equipment. Most children do not complete elementary school, and few people enter college.

From ancient times until the 1800's, most people—even in advanced societies—never attended school. In ancient Greece, for example, only the sons of citizens could attend school, and most Greek residents were not citizens. During the Middle Ages, which lasted from about A.D. 400 to the 1500's, the Roman Catholic Church ran cathedral and monastery schools in Europe, chiefly to train young men for the priesthood.

Widespread development of public schools began in the early 1800's, when government leaders in many countries acted on the belief that a nation's progress depends on educated citizens. By the mid-1800's, the United States, Canada, and many European countries had established public school systems.

This article discusses schools in the United States and Canada. For information about schools in other countries and education in general, see EDUCATION. See also the *Education* section in the articles on states, provinces, and countries.

Willard Abraham, the contributor of this article, is Professor of Education and Chairman of the Department of Special Education at Arizona State University.

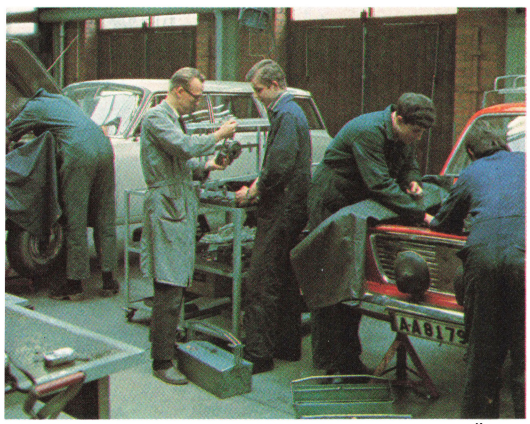


Marc & Evelyne Bernheim, Woodfin Camp, Inc.

Village School in Ivory Coast

Photophile

University of California at Los Angeles



Herbert Fristedt from Carl Östman

Vocational School in Sweden

J. Alex Langley, DPI

High School Chemistry Lab in Mexico

SCHOOL/*Kinds of Schools*

The chief kinds of schools in the United States and Canada are (1) nursery schools, (2) kindergartens, (3) elementary schools, (4) middle schools, (5) junior high schools, (6) high schools, (7) junior colleges, and (8) colleges and universities.

Nursery Schools, sometimes called *preschools*, are designed mainly for children 3 and 4 years old. Most of these schools use play activities and informal methods of instruction to help prepare youngsters for kindergarten or elementary school. The schools help children learn how to work and play together. They also teach youngsters skills they will need later in school. Nursery schools called *child-care*, or *day-care*, *centers* have been set up in many communities. A number of these centers only provide care for children and do not offer planned educational programs.

The United States and Canada have many nursery schools, and the demand for them increases every year. But no reliable estimate of the number of nursery schools is available because most of them are privately controlled, and many are very small.

Kindergartens teach children during the year before they begin their elementary education. Like nursery schools, kindergartens are sometimes called *preschools*. Some states require all elementary school districts to have kindergartens, which are considered part of elementary education in these states. Most kindergarten children are 5 years old. Some of them enter kindergarten after nursery school. But for many other youngsters, kindergarten is their first school experience.

Most kindergartens continue the informal methods used in nursery school. Some kindergartens also give children their first formal preparation for reading, writing, and other subjects. Most kindergartens are located in public elementary schools, and the majority of school systems in both the United States and Canada include kindergartens. See KINDERGARTEN.

Elementary Schools provide formal education in such basic subjects as arithmetic; science; social studies; and communication skills, including reading, writing, spelling, and speaking. Most elementary schools have six or eight grades and teach children from age 6 to age 12 or 14. This type of elementary school, in which students of about the same age are all in the same grade, is also called a *grade school* or *grammar school*.

Some communities have *nongraded*, or *ungraded*, elementary schools. Students in these schools are not grouped in grades according to age. Instead, each child

WORLD BOOK photo

Community Schools serve the community in general as well as its children. Many community schools offer handicraft and other courses for adults, *above*, besides the regular school program.

advances in each subject at his or her own rate. Children attend classes with other youngsters who have advanced to the same level. Pupils transfer to a higher-level school when they reach the required age, provided that their progress is satisfactory.

The United States has about 80,000 elementary schools, of which about 66,000 are public. Canada totals its elementary and high schools together. It has about 16,000 elementary and high schools, of which about 15,100 are public. See ELEMENTARY SCHOOL.

Middle Schools. Some U.S. communities have elementary schools that end with grade 4 or 5 rather than grade 6 or 8. In these communities, students enter a three- or four-year middle school after elementary school. Most middle schools offer the same kinds of educational programs offered in upper elementary school. But middle schools separate students from the younger elementary-school children, which helps prepare them for attending high school with older students. The United States has about 2,000 middle schools. See MIDDLE SCHOOL.

Junior High Schools offer two or three years of education after six years of elementary school. Junior high schools, like middle schools, continue the type of general education begun in elementary school. But unlike middle schools, they introduce students to the kind of class schedule and assignments they will find in high school. The United States has about 7,750 public junior high schools. There are relatively few junior high schools in Canada. See JUNIOR HIGH SCHOOL.

High Schools in the United States provide three, four, or six years of education, depending on the organization of a community's school system. Systems with a three-year junior high school have a three-year *senior high school*. If the junior high school provides two years of education, the senior high school provides four years. Systems with a middle school or an eight-year elementary school have a four-year high school. Some communities have six-year elementary schools and six-year high schools. Most Canadian high schools offer a four- or five-year program. High schools, including junior high schools, are also called *secondary schools*.

Most high schools provide both *college preparatory* and *vocational* programs. A college preparatory program consists mainly of such subjects as history, language, mathematics, and the physical and social sciences. Vocational programs provide training mainly in various job skills for students who do not plan to enter college. Some schools offer either a college preparatory program or a vocational program, not both.

The United States has about 15,100 public high schools. They consist of about 4,600 three-year schools, 6,600 four-year schools, and 3,900 six-year schools. There are also about 3,700 private U.S. high schools. Private secondary schools that prepare students for college are called *preparatory schools*. See HIGH SCHOOL.

Junior Colleges, often called *community colleges*, provide from one to three years of study after high school, though most have a two-year program. They offer two kinds of educational programs. One program consists of courses much like those taken during the first two years at a four-year college. It prepares students for further study at a college or university. The other type of program offers specialized job training.

The United States has about 960 junior colleges, of which about three-fourths are public. Canada has about 200 community colleges, most of which are also public. The U.S. junior colleges grant an associate's degree for completion of the program leading to further study at a college or university. The Canadian schools do not grant degrees. See JUNIOR COLLEGE.

Colleges and Universities offer advanced study after high school or junior college in a variety of fields. Most colleges have four-year programs leading to a bachelor's degree in the arts or sciences. Many also offer programs of further study leading to a master's or doctor's degree.

Most universities consist of a number of colleges and schools. For example, a university may include colleges or schools of business administration, dentistry, education, engineering, law, and medicine, as well as a college of arts and sciences. Depending on the course of study they offer, the various colleges and schools award bachelor's, master's, or doctor's degrees.

The United States has about 450 public and about 1,250 private colleges and universities. Canada has about 60 degree-granting institutions, most of which are public. See UNIVERSITIES AND COLLEGES.

Other Kinds of Schools in the United States and Canada provide special types of education. Some schools are designed for handicapped or gifted children. Other schools provide vocational courses for adults. If such a school is owned by a private group or business firm, it is called a *proprietary school*. Correspondence schools, many of which are proprietary schools, offer home-study courses through the mail. Night schools provide courses for people who work during the day. See CORRESPONDENCE SCHOOL; NIGHT SCHOOL; SPECIAL EDUCATION; VOCATIONAL EDUCATION.

Most schools in the United States and Canada are publicly controlled and financed. Authority over these schools rests mainly with the states in the United States and with the provinces and territories in Canada. But local school districts have much responsibility for operating the schools. The only exception is Hawaii, where the state directly controls all public schools.

This section chiefly describes how public schools operate in local districts of the United States and Canada. For information about federal, state, and provincial authority over these schools, see EDUCATION (Education in the United States; Education in Canada). For information about the role of the teacher in school, see TEACHING.

Public School Districts are set up by state governments in the United States and by provincial and territorial governments in Canada. Some large districts cover an entire city. Small districts may consist of a small town or a thinly populated rural area. The United States has about 16,300 public school districts, and Canada has about 1,050.

Some school districts in the United States and Canada provide only elementary schooling or secondary schooling, not both. But most districts provide both elementary and secondary schools. A district may use any of the plans of school organization described in the section *Kinds of Schools*. In many areas of the United States, two or more small rural districts have combined to form a *consolidated*, or *unified*, *school* (see CONSOLIDATED SCHOOL). Many smaller Canadian districts have also combined to form larger districts.

Each school district in the United States has a board of education, or school board, responsible for public education in the district. In addition, most districts have a superintendent of schools, appointed by the board, who supervises school operation. Most districts in Canada also have a school board and superintendent. But many smaller districts are run as part of larger, regional districts. School board members in both countries are either elected by the people of the school district or appointed by the local government.

A district's board of education sets general policies regarding such matters as the hiring of teachers, the planning of courses of study, and the maintenance of buildings and grounds. The superintendent sees that district schools carry out the board's policies. In most districts, the board and superintendent hire principals and have final responsibility for hiring teachers. When special problems arise, such as the need for a new school building, the board may appoint a committee of citizens to recommend solutions. In a large school district, several assistant superintendents may help supervise school operation.

Public School Administration. In most public schools, a principal serves as chief administrator. This person directs the operation of the school according to policies set by the school board. The exact duties of a principal vary among school districts. But most principals have partial responsibility for hiring the school's employees, developing educational programs, and planning each year's budget. They generally share this responsibility with the superintendent and board.

Almost all high schools and many elementary schools have teachers who specialize in such basic subjects as English, history, mathematics, or science. Other teachers help students develop skill in athletics, music, and other fields. In addition, many schools have teachers who work with handicapped or gifted children.

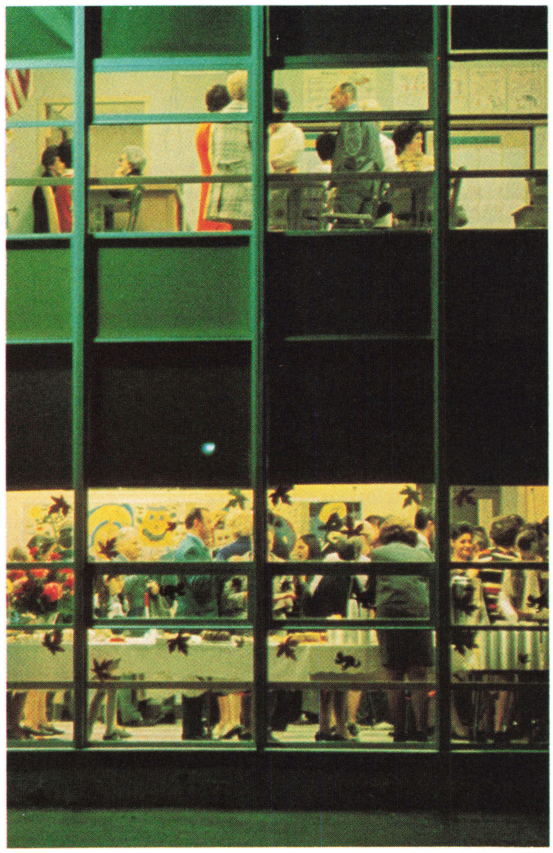
Many schools also have other specialists in addition to classroom teachers. These specialists include librarians, nurses, and *dietitians*, who supervise the planning of menus and the preparation of food in the cafeteria. Many high schools have one or more guidance counselors. They help students plan their courses and also help them deal with personal or family problems.

Most principals work with teachers in planning how the various courses of study will be taught. The planning involves reviewing the subject matter to be covered and selecting the textbooks and other educational materials. The principal may also meet with teachers regarding disciplinary problems or other matters of concern to the school.

Operating a school requires much money. Most principals work with the superintendent to prepare a yearly budget of estimated costs. These costs include not only the expense of the teaching program but also of such special activities and services as athletics programs and the school cafeteria. The budget must also include oper-

WORLD BOOK photo

A School Board is elected or appointed to run the public schools in a local school district. These boards, like the one at the right, meet regularly to decide school policy, finances, hiring practices, and other matters.



WORLD BOOK photo

A PTA Open House, *above,* enables parents to tour their children's school, see exhibits of their work, and meet their teachers. Most schools encourage such parent-teacher cooperation.

Carl Purcell

A School Orchestra is one of many school activities that require specially trained teachers and special equipment.

Jeffrey Blankfort, B.B.M. Associates

Special School Services, such as this cafeteria, require the hiring of dietitians, nurses, and other nonteaching employees.

ating and maintenance costs, such as fuel and electrical bills. The amount of money available to the school has to be carefully considered in planning the budget. The sources of financial support for schools are discussed later in this section.

Private School Administration. Private schools in the United States and Canada are operated by religious groups and other private organizations. The controlling organization appoints various administrators, who have about the same responsibilities as public school principals and superintendents. These administrators operate according to policies set by the private organization rather than by a public school board. But private schools must meet certain government standards regarding the quality of the education they offer.

Some private schools operate for a profit. But most, such as those run by religious groups, are nonprofit organizations. Private schools operated by religious groups are also called *parochial schools*. The term applies especially to elementary and high schools. For more information about parochial and other private schools, see PRIVATE SCHOOL; PAROCHIAL SCHOOL.

Financial Support for the day-to-day operation of public schools in the United States and Canada comes almost entirely from taxes. Major long-range projects, such as the construction of a school building, are often financed by bond issues. School bonds require approval of the voters in the district and are repaid from public tax receipts over a long period of time.

In the United States, local school districts provide about 50 per cent of the tax money needed for public school operations. The states provide about 40 per cent, and the federal government about 10 per cent. In Canada, the provinces and territories pay about 50 per cent of public school costs, local communities about 40 per cent, and private sources about 9 per cent. The federal government supplies only about 1 per cent of the necessary funds.

Private schools in the United States receive almost all their financial support from private sources, such as tuitions, gifts, and church donations. Quebec and several other Canadian provinces help support Roman Catholic and Protestant schools with tax money. But in some Canadian provinces, private schools receive little or no government assistance.

For more information about the financial support of U.S. schools, see EDUCATION (Financial Support; How Should Education Be Financed?).

This section discusses the development of schools in the United States and Canada since colonial days. But the origin of U.S. and Canadian education actually dates back to ancient times. The *History* section of the EDUCATION article traces the general history of education from ancient times to the present. It also provides additional information about the development of U.S. and Canadian schools.

Development of U.S. Schools

Colonial Schools. The first schools in what is now the United States were established in the early 1600's by colonists who came from Europe. They set up private schools to teach reading, writing, and religion. In 1636, the Massachusetts Bay Colony founded Harvard College, the first institution of higher learning in the American Colonies.

In 1647, Massachusetts passed the first law in the colonies to require the establishment of public schools. The law required every town with at least 50 families to start an elementary school for all children. In addition, every town with 100 families or more had to set up a Latin grammar school. These secondary schools emphasized instruction in Latin and were designed chiefly to prepare boys for college.

In the 1700's, private secondary schools called *academies* opened in many colonies. They taught bookkeeping, navigation, and other practical subjects in addition to such subjects as English and Latin. Some academies admitted girls, and some were established for girls only.

Colonial school buildings were simple log or wood-frame structures. Most of them consisted of one room with a stove in the middle and a few windows. They had benches or crude wooden desks for the students.

The first school districts were established in New England during the mid-1700's. But the district system did not become widespread until the 1800's.

The Growth of the Public School System. The demand for public education increased in the United States during the early 1800's. American political leaders, like those in Europe, saw that a nation's economic and social well-being depended on educated citizens. Labor unions in the growing cities also demanded schools for the children of workingmen. In response, state legislatures gave communities authority to collect property taxes to pay for schools. The states themselves also began to give financial aid to school districts.

In 1837, Massachusetts appointed the nation's first state board of education and the first state secretary of education. Horace Mann, one of the greatest champions of U.S. public education, was the first secretary. The board's job was to set school policy. The secretary's job was to supervise the formation and operation of school districts. Soon, many other states also established a board of education and appointed a state official to administer the school system.

After 1850, states began to pass *compulsory* school-attendance laws. These laws required children to attend school until they completed a certain grade or reached a certain age. Today, every state except Mississippi has such a law.

The Expanding Role of Public Schools. During the 1800's, new kinds of public schools were started. For example, Boston started the nation's first public high school in 1821. In 1851, Massachusetts established the first public school for mentally retarded children. The first public kindergarten in the United States opened in St. Louis in 1873. Also during the 1800's, public schools began to offer new courses of instruction. For example, they started physical education classes in the 1870's and *manual training* classes in the industrial arts in the 1880's. Schools introduced homemaking classes for girls about 1890.

The public school served as a center of community activity throughout most of the 1800's. Spelling bees, town meetings, and other special events were held in the school. But community use of the school began to decline in the late 1800's, chiefly because many communities outgrew their school. The building was no longer large enough for community gatherings.

Improvements in School Design began in the mid-1800's. Until that time, most school buildings were still made of wood and consisted of one room. All the children were taught together, without regard to grade level. Then in 1847, Quincy Grammar School in Quincy, Mass., divided students into grades and taught the grades separately. The school thus became the first graded public school in the United States. In 1848, Quincy Grammar School moved to a new building that had 12 classrooms. From that time on, most other new schools in towns and cities were designed with a separate room for each grade.

After about 1900, the majority of schools were built of brick and concrete to meet stricter construction standards. Because earlier schools were built largely of wood, they presented a serious fire hazard. Schools also began to have special rooms in addition to regular

The New Canaan Historical Society, Connecticut

The One-Room School was common in U.S. rural areas during the 1800's. Most had one teacher, who taught all grades. This picture shows such a school in New Canaan, Conn., in the 1890's.

classrooms. These special rooms included a gymnasium, a library, a science laboratory, and rooms for art and music classes. School designers also started to provide playground space around city schools, instead of crowding the schools in among other buildings.

As school design improved in the early 1900's, the school again became an important center of community activity. The new schools provided space for meetings and other community gatherings. Also, the gymnasium and other new facilities were used for recreation and for evening classes.

The Mid-1900's. The economic depression of the 1930's and World War II (1939-1945) interrupted school development in the United States. After the war, the nation could again afford to invest in education. In addition, a greatly increased birth rate created a need for more schools. As a result, a tremendous building boom in schools occurred across the nation during the late 1940's and the 1950's.

Recent Developments. Several new kinds of schools were developed in the 1960's and early 1970's. These schools include community schools, alternative schools, and open schools.

The increased community use of schools, which has continued since the early 1900's, has led to the creation of more and more *community schools*. These schools serve the needs of the community in general as well as its children. The school auditorium, for example, may be designed large enough so that concerts and other forms of entertainment can be presented to the public.

Many *alternative schools* have been started by parents, religious organizations, and other private groups. The majority of these schools are elementary schools. Most of them give students the freedom to decide what and how they will study. For this reason, they are also called *free schools*. Alternative schools in the poor sections of cities are sometimes called *storefront schools* because many of them have been set up in buildings that were once stores.

In some communities, architects have designed *open schools*. Most of these schools are elementary schools. The classrooms have no walls separating them, or they have movable walls. Space can thus be used in a variety of ways. For example, several classes may gather in one large classroom. Students may work individually on different subjects in different parts of the room. Many open schools have a *learning center*, or *media center*, where students work individually with teaching machines, tape recorders, and other *audio-visual materials* (see AUDIO-VISUAL MATERIALS).

Development of Canadian Schools

Roman Catholic settlers from France set up the first schools in what is now Canada in the early 1600's. From then until the mid-1700's, the Catholic Church controlled most Canadian schools. Elementary schools, taught mainly by priests, provided instruction in reading, writing, arithmetic, and religion. Jesuit priests began a number of Latin schools, which were similar to the Latin grammar schools in the American Colonies.

Great Britain gained control of Canada in 1763. After that date, English settlers started many Protestant schools in Canada. These schools included both elementary schools and schools for boys who had completed their elementary education.

Canada's first public school systems were started after 1800. The British tried to create a single school system in Quebec for both French-speaking Roman Catholics and English-speaking Protestants. But Catholics opposed the plan. In the 1840's, Quebec established separate Protestant and Catholic school systems. Ontario, which was largely English-speaking and Protestant, set up a system of separate religious and public schools in the 1850's and 1860's.

The British North America Act, passed by the British Parliament in 1867, united Canada's provinces under one government. The act left education under provincial control. It also guaranteed public support for religious schools in Quebec, Ontario, and other provinces that had been providing such support.

During the late 1800's, elementary education became publicly financed and compulsory throughout Canada. The nation's first public high school opened in Ontario in 1871, and kindergartens were introduced in the 1880's. In the early 1900's, schools began to offer new kinds of classes, such as physical education and manual training. New types of public schools also opened, including vocational high schools and schools for handicapped persons.

During the 1960's, public school enrollments in Canada rose dramatically. For example, the number of students in public high schools nearly doubled during this period. To meet the increased enrollments, many new schools were opened, including such new kinds as alternative schools and open schools. In addition, the federal and provincial governments greatly increased their financial aid to public schools. In the 1970's, high school enrollments have continued to rise. But a lower birth rate in the mid-1960's has cut elementary school enrollments.

WILLARD ABRAHAM

SCHOOL / *Study Aids*

Related Articles. See EDUCATION and the *Education* sections of the various state, province, and country articles. See also the following articles:

KINDS OF SCHOOLS

Academy
Boarding School
Consolidated School
Correspondence School
Elementary School
Graduate School
High School
Junior College
Junior High School
Kindergarten
Laboratory School
Night School
Nursery School
Parochial School
Preparatory School
Private School
Universities and Colleges

OTHER RELATED ARTICLES

Architecture (How an Architect Designs a Building)
Colonial Life in America (The School)
Grading
Library (School Libraries)
School Lunch
Special Education
Sports and Sportsmanship (Sports in the School)
Teaching
Theater (Professional Theater Schools)
Vocational Education

Outline

I. **Kinds of Schools**
   A. Nursery Schools
   B. Kindergartens
   C. Elementary Schools
   D. Middle Schools
   E. Junior High Schools
   F. High Schools
   G. Junior Colleges
   H. Colleges and Universities
   I. Other Kinds of Schools
II. **How Schools Operate**
   A. Public School Districts
   B. Public School Administration
   C. Private School Administration
   D. Financial Support
III. **History**

Questions

What are some of the general purposes of schools?

Which of the American Colonies passed the first law requiring establishment of public schools? When?

Where does almost all the financial support for U.S. and Canadian public schools come from?

How do junior high schools and middle schools differ?

When did widespread development of public schools begin?

What are *parochial schools? Nongraded schools?*

What levels of government set up public school districts in the United States and Canada?

How does the number of grades in high school vary according to the organization of a school district?

How did U.S. school design change in the mid-1800's?

What new kinds of schools were developed in the United States in the 1960's and early 1970's?

SCHOOL (of water animals). See DOLPHIN; FISH (How Fish Live Together); PILOT WHALE; SARDINE; WHALE (Life of the Whale).

SCHOOL ADMINISTRATORS, AMERICAN ASSOCIATION OF, is a professional association of about 18,000 school administrators and professors of school administration. It is associated with the National Education Association of the United States.

The association holds important national and regional conferences. These conferences help school administrators discuss practical problems in their work and current issues in education. The association also publishes information on educational issues. It was founded in Harrisburg, Pa., in 1865. Headquarters are at 1801 N. Moore Street, Arlington, Va. 22209.

Critically reviewed by AMERICAN ASSOCIATION OF SCHOOL ADMINISTRATORS

SCHOOL LUNCH is a noon meal served to children in school. In the 1800's, Germany, France, and other European countries began to serve lunches in their public schools. By 1900, New York, Philadelphia, Chicago, and other large cities started the program in the United States, when they began to feed hungry children at school. By 1925, many city and country schools throughout the United States served lunches as hot noon meals. The practice soon spread throughout a great part of the United States.

The value of a hot lunch at school greatly impressed both parents and teachers. Gradually, many schools came to employ lunchroom managers with training in home economics or dietetics. Most teachers now accept lunch programs as important educational devices for teaching good food habits and social skills.

Federal assistance to school lunch operations began in 1933. This support stimulated the program; more children came to participate; and the nutritional quality of the lunches improved. A *Type-A* lunch supplies from one-third to one-half of a child's daily nutritional requirements. It contains foods from all seven of the basic groups (see NUTRITION [The Basic Seven]). In the early 1970's, the National School Lunch Program provided lunches for about 21 million children each year. Federal, state, and local groups contribute funds that help support this program's work. JANICE M. SMITH

SCHOOL OF FOREIGN SERVICE. See GEORGETOWN UNIVERSITY.

SCHOOL OF MONTREAL. See CANADIAN LITERATURE (Since 1900).

SCHOOL OF QUEBEC. See CANADIAN LITERATURE (Literary Expansion).

SCHOOLCRAFT, HENRY ROWE. See MINNESOTA (Louisiana Purchase).

SCHOONER. See SAILING with pictures.

SCHOPENHAUER, *SHOH puhn HOW ur,* **ARTHUR** (1788-1860), a German philosopher, became widely known for his fine prose style and his pessimism. His philosophy is atheistic, but the Eastern religions, especially early Hinduism and Buddhism, profoundly influenced him (see BUDDHISM; HINDUISM). He described blind will as the ultimate reality, and he sought release from suffering through the contemplation of works of art and an ethic of sympathy. His main work is *The World as Will and Idea* (1819, 1844). Some of Schopenhauer's essays in the collection *Parerga and Paralipomena* (1851) have also been widely read, especially his bitter discussion "On Women."

Schopenhauer was born in Danzig (now Gdańsk, Poland). He trained for a business career, but turned to philosophy after his father, a banker, died. He denounced Johann G. Fichte, Friedrich Schelling, and G. W. F. Hegel. Schopenhauer's philosophy became popular in the last 10 years of his life. WALTER KAUFMANN

SCHOTTISCHE, *SHAHT ish,* is the name of a German dance, popular in the 1800's. Its hopping and sliding steps are in $\frac{2}{4}$ time.

SCHOUTEN, WILLEM CORNELIS. See ADMIRALTY ISLANDS; TONGA; CAPE HORN.

SCHOUTEN ISLANDS, *SKOU tun,* lie north of New Guinea in the South Pacific Ocean. They were once part of Netherlands New Guinea. In 1963, they were ceded to Indonesia and are now part of Irian Jaya (West New Guinea). They cover 1,236 square miles (3,201 square kilometers) and have a population of about 37,000. Biak and Soepiori are the largest islands. During World War II, Allied and Japanese forces fought in this area. See also INDONESIA (map). EDWIN H. BRYAN, JR.

SCHRICKER, HENRY FREDERICK. See INDIANA (The Mid-1900's).

SCHRIEFFER, JOHN ROBERT. See NOBEL PRIZES (table: Nobel Prizes for Physics—1972).

SCHRÖDINGER, *SHRAY ding ur,* **ERWIN** (1887-1961), was an Austrian theoretical physicist and Nobel prize winner. In 1925, he put into mathematical form the revolutionary idea of a French physicist, Louis Victor de Broglie, that the motion of material particles is guided by so-called *pilot waves.* The formulation of the "Schrödinger equation" put quantum theory on a strict mathematical basis, and provided the foundation for its further rapid expansion (see QUANTUM MECHANICS). For

this work, Schrödinger shared the 1933 Nobel prize for physics with Paul Dirac of Cambridge, England.

In later years, he concerned himself with the extension of Albert Einstein's theory of gravitation to include electrical and magnetic phenomena. He also became interested in fundamental biology, and published a short popular book, *What Is Life?* (1945). In this book, he attempted to explain the phenomena of life on the basis of purely physical concepts.

Schrödinger was born in Vienna, and received his Ph.D. from the university there. He served as a professor of theoretical physics in several universities in Germany and Switzerland. He was also associated with the Dublin Institute for Advanced Studies. G. GAMOW

SCHUBERT, *SHOO bert*, **FRANZ PETER** (1797-1828), an Austrian composer, wrote an astonishing variety of music in many forms. He was one of the greatest creators of melody, and perhaps the leading composer of *lieder* (German songs).

His Life. Schubert was born in Vienna on Jan. 31, 1797. He was the son of a poor schoolmaster. By the time he was 11, he was a choirboy. He attended school at the Imperial and Royal Seminary, and played the violin and sometimes conducted there. Schubert was composing when only 13, and wrote his first song the next year. He began his first symphony in 1813. He was 18 when he wrote the well-known song "Gretchen at the Spinning Wheel." In 1815, he wrote such outstanding lieder as "Hedge Roses" and "The Erl King," as well as his second and third symphonies, and several works for the musical stage.

Schubert taught for a time in his father's school, then went to live with his friend Ferdinand Schober in 1816. Schubert's operas failed to earn much money, and he suffered greatly from poverty because he lived a disorganized and easygoing life. In 1826, he tried, but failed, to get a position at the court of the Austrian emperor. Although he composed constantly and gained some recognition, Schubert managed to get only a few of his works published. He never achieved real success.

Schubert foolishly neglected his health. He planned to visit Hungary in 1828, the year in which he composed several of his major works. But he became very ill, and had to abandon the trip. On Nov. 14, 1828, Schubert contracted typhus. He died five days later.

Schubert was the classic example of a man of genius who was so devoted to his art that he never managed to live well or adjust to the world. He never married. His music and his personal charm won him admiring friends, but he gained little public recognition. Schubert heard only a few of his great orchestral works performed, and his great *Symphony in C major* was not performed during his lifetime. Ten years after his death, his brother Ferdinand gave the manuscript to Robert Schumann. Schumann in turn gave it to Felix Mendelssohn, who conducted the work in Leipzig. Ferdinand made many of Schubert's other works available for publication.

But posterity has made up for the neglect Schubert suffered while he was alive. He never went far beyond Vienna. But his music, crossing borders throughout the world, has become a lasting international treasure.

His Works. Schubert's orchestral works include dances, overtures, and symphonies. The two-movement *Symphony No. 8 in B minor* ("Unfinished") has long been a public favorite. Many regard Schubert's *Symphony in C major* (known either as No. 7 or No. 9), as his greatest masterpiece. His charming chamber music varies from an octet and two quintets to many string quartets and piano trios, as well as sonatas for piano and violin. Schubert also wrote many pieces for solo piano, notably sonatas, *impromptus*, waltzes, and *Moments Musicaux* (Musical Moments). He also composed many works for piano duet.

Schubert was especially attracted to the musical possibilities of the human voice. He composed much religious music, including Masses, and choral pieces to nonreligious texts. He wrote several operas and operettas. But these works lacked theatrical effectiveness and failed. However, Schubert's incidental music for the play *Rosamunde, Princess of Cyprus*, is still popular.

Schubert's special contribution to music lies in his more than 600 solo lieder. These include the *cycles* (groups of related songs) called *Die schöne Müllerin* (*The Beautiful Mill-Girl*), *Winterreise* (*Winter Journey*), and *Schwanengesang* (*Swan Song*). Such separate songs as "Ave Maria," "Death and the Maiden," "Serenade," "The Trout," and "Who Is Sylvia?" are among the greatest in song literature. No other composer has written so many expressively beautiful songs of such high quality. See LIEDER.

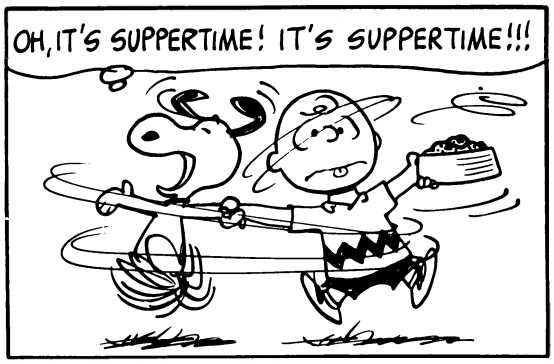
Schubert was not a man of searching and tough-fibered intellect like Beethoven, a man he admired greatly. Schubert sometimes was unable to sustain his musical ideas once he had presented them in larger forms. Some critics feel that many of his sonatas are too long for the musical ideas they contain. But Schubert was especially gifted in creating melody, and his poetic inspirations easily carry the listener through some perhaps needless repetition. This problem does not arise in his astonishing lieder. These songs would give Schubert a place among the great composers even if he had written nothing more. HERBERT WEINSTOCK

Detail of a watercolor portrait (1825) by Wilhelm August Rieder. *Historisches Museum der Stadt Wien* (Art Reference Bureau)

Franz Schubert

SCHULZ, CHARLES MONROE (1922-), created the "Peanuts" comic strip. His simply drawn characters are children who make funny but wise statements about life. Charlie Brown, Lucy, Linus, and the others—including Snoopy, the dog—appeal to both children and adults.

Schulz was born in Minneapolis, Minn. He based much of the Charlie Brown character on his own childhood. Schulz had trouble with his studies because he skipped two grades. In high school, he did poorly in sports and was too shy to ask a girl for a date. The high school yearbook even rejected the cartoons he submitted. But Schulz continued to draw and, in the late 1940's, he began selling cartoons to magazines and newspapers. In 1950, he started "Peanuts," with Charlie Brown, a born loser, as the main character of the strip. "Peanuts" appears in more than 1,200 news-



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Snoopy and Charlie Brown are two leading characters in Charles Schulz's comic strip, "Peanuts." Snoopy is a beagle who acts human. Charlie Brown fails in everything he tries to do.

papers in the United States and Canada and in newspapers in about 60 other countries. ROY PAUL NELSON

SCHUMAN, WILLIAM (1910-), is an American composer and administrator. His compositions include ballets, such as *Undertow;* six symphonies; and many choral and chamber music works. His music has won several awards, including a 1943 Pulitzer prize, two Guggenheim fellowships, and a grant from the Metropolitan Opera. Schuman was born in New York City. After teaching music at Sarah Lawrence College and Columbia University, he was made president of the Juilliard School of Music in 1944. Schuman served as president of the Lincoln Center for the Performing Arts from 1962 to 1968. HOMER ULRICH

SCHUMAN PLAN. See EUROPEAN COMMUNITY.

SCHUMANN, *SHOO mahn,* **CLARA** (1819-1896), was one of the finest pianists of her time and the wife of the German composer Robert Schumann. She was also a composer. Schumann included passages from many of her works in his compositions.

Clara Schumann was born in Leipzig, Germany. She studied with her father, Friedrich Wieck, a famous piano teacher. Wieck opposed her engagement to Schumann, another of his pupils, but the couple were married in 1840. While raising their eight children, Clara Schumann found time to learn hundreds of piano works. She became the first pianist to play entire concerts from memory.

In 1853, the Schumanns met the composer Johannes Brahms, who became their devoted friend. Brahms and Clara Schumann encouraged performances of her husband's works after Schumann died in 1856. From 1872 to 1892, she headed the piano department at the Frankfurt Conservatory. JAMES SYKES

See also SCHUMANN, ROBERT.

SCHUMANN, *SHOO mahn,* **ROBERT** (1810-1856), was a German composer and writer on music. Some critics consider him the most important composer of the German romantic movement. He became best known for his brilliant piano compositions and beautiful songs.

His Works. Schumann's compositions represent the two contrasting moods of romantic music. One mood is emotional, impulsive, and stormy, and the other is quiet and reflective.

Schumann's chief works for piano include *Symphonic Études* (1834), *Fantasia in C major* (1836), and *Concerto in A minor* (1845). He also composed a number of short pieces, many of which he organized in groups. These include *Papillons* (1829-1831), *Carnaval* (1834-1835), *Kinderscenen* (1838), and *Kreisleriana* (1838). His *Album for the Young*, a collection of pieces for piano students, was published in 1848.

Lithograph (1839) by Josef Kriehuber; Photo Archives and Portrait Collection, Austrian National Library, Vienna

Robert Schumann

Schumann composed four symphonies; chamber and choral music; an unsuccessful opera, *Genoveva* (1850); and other works. His songs rank with those of Franz Schubert among the finest German *lieder* (art songs). In 1840, the year of his marriage, Schumann wrote over 100 songs.

Schumann had a strong influence on various composers of the late 1800's, especially Johannes Brahms of Germany and Edvard Grieg of Norway. His music also influenced several French and Russian composers.

In 1833, Schumann helped found the *Neue Zeitschrift für Musik*, a leading music journal. He edited the publication from 1835 to 1844 and wrote many articles for it until 1853. These articles did much to establish the early reputation of such composers as Brahms, Hector Berlioz of France, and Frédéric Chopin of Poland.

His Life. Schumann, the son of a bookseller and publisher, was born in Zwickau. He began piano lessons at the age of about 7.

In 1828, Schumann entered the University of Leipzig with the goal of studying law. But he neglected his legal studies and devoted most of his time to music and writing. After a year at the University of Heidelberg, he returned to Leipzig in 1830. Schumann studied piano under the noted teacher Friedrich Wieck. But he injured a finger in 1832, which forced him to abandon his hopes for a career as a concert pianist.

About 1835, Schumann fell in love with Wieck's 16-year-old daughter Clara, a brilliant pianist. Wieck felt that Clara was too young and Schumann's future too uncertain for marriage. Despite his objections, the couple were married in 1840 (see SCHUMANN, CLARA).

Schumann began to show signs of mental illness in the early 1840's, and he later suffered a severe breakdown. He accepted the position of musical director of the Düsseldorf symphony orchestra in 1850, but his increasing mental illness caused difficulties with the musicians. Schumann resigned in 1853. Early in 1854, he tried to commit suicide by jumping into the Rhine River. He was rescued and placed in an asylum, where he died. R. M. LONGYEAR

SCHUMANN-HEINK, *SHOO mun HYNK,* **ERNESTINE** (1861-1936), was a greatly admired contralto. During her long and active career as an artist, she appeared in operas, oratorios, concerts, and even motion pictures and vaudeville. She made her debut in Graz, Austria, when she was 15, as contralto soloist in Beethoven's *Symphony No. 9.* Madame Schumann-Heink first sang in opera at Dresden in 1878. Her growing reputation

earned her invitations to the Wagner festivals at Bayreuth, Germany, from 1896 to 1903 and in 1905 and 1906. She joined the Metropolitan Opera Company of New York in 1899 after an American debut in Chicago. Later, she toured extensively as an interpreter of *lieder* (German songs). Madame Schumann-Heink was born near Prague, Czechoslovakia. SCOTT GOLDTHWAITE

SCHUMPETER, JOSEPH ALOIS (1883-1950), was a noted economist of the first half of the 1900's. Schumpeter gained prominence for his studies of economic growth, business cycles, and the conflict between capitalism and socialism.

In his first major work, *The Theory of Economic Development* (1911), Schumpeter argued that growth in a private enterprise economy was caused by forceful, daring *entrepreneurs* (business organizers) who hope to make large profits. The entrepreneur did something new. His innovation might be a new product, invention, or process that would lead to new industries and markets. In *Business Cycles* (1939), Schumpeter suggested that new developments generally came irregularly and in bunches. He said this condition created cycles of good and bad times.

In *Capitalism, Socialism, and Democracy* (1942), Schumpeter said that government efforts to reduce unequal distribution of income and to eliminate business cycles would destroy the conditions in which entrepreneurs could flourish, and that the growth of big business would eliminate the entrepreneurs from decision-making positions in industry. Capitalism would then lose its ability to grow and develop, and the resulting economic conditions would lead to socialism.

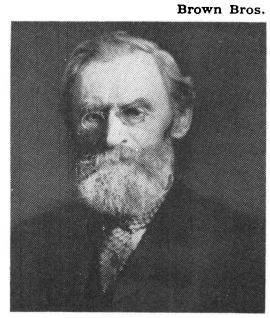
Schumpeter was born near Jihlava, Czechoslovakia, and was educated at the University of Vienna. He taught briefly at Harvard University in the late 1920's, joining Harvard's regular faculty in 1932. Schumpeter became a U.S. citizen in 1939. DANIEL R. FUSFELD

SCHURZ, *shoorts*, is the family name of an American statesman and his wife, an educator.

Carl Schurz (1829-1906) was an American editor, soldier, and political leader. He has been called the greatest American citizen of German birth. He was born at Liblar, Prussia, and attended the University of Bonn. He fought in the revolution of 1848-1849 against the autocratic rulers of the German states. After the revolution failed, he escaped to Switzerland. Schurz then made his way to the United States.

Schurz settled in Wisconsin, and became a leader in the antislavery fight. He campaigned for Abraham Lincoln in the election of 1860. Lincoln named him minister to Spain. During the early years of the Civil War, Schurz was in Madrid safeguarding the Union cause. Later, he resigned to become a brigadier general in the Union Army. After the war, he established the *Westliche Post*, a German-language newspaper, in St. Louis, Mo. It soon became a powerful influence in the West. In 1869, he was elected a Republican United States senator from Missouri, and soon became a leader of the opposition against the measures of President Ulysses S. Grant. He helped form the Liberal Republican Party, which fought Grant in the election of 1872.

Carl Schurz
Brown Bros.



President Rutherford B. Hayes appointed Schurz secretary of the interior in 1877, a post he held until 1881. As secretary, he argued for fair treatment of the Indians, and installed a civil-service merit system in his department (see CIVIL SERVICE). Later, he became editor of the New York *Evening Post*, and from 1892 to 1898, he was chief editorial writer for *Harper's Weekly*. W. B. HESSELTINE

Margaretha Meyer Schurz (1834-1876) was the wife of Carl Schurz. In Germany, she had been a pupil of Friedrich Froebel, the founder of the kindergarten. She came to the United States with her husband in 1852. In 1856, she established a school at Watertown, Wis., for the young German-speaking children of immigrants. This school was the first kindergarten in the United States. Mrs. Schurz also supported her husband's activities as a leader of German immigrants, and as a United States senator. CLAUDE A. EGGERTSEN

See also KINDERGARTEN (picture).

SCHUSCHNIGG, *SHOOSH nik*, **KURT VON** (1897-), was chancellor of Austria until Adolf Hitler forced Austria to unite with Germany in 1938. In the Vienna rebellion of 1934, he played a leading part in suppressing the Socialists, and seized power as chancellor after the assassination of Engelbert Dollfuss. Schuschnigg opposed the Nazi seizure of Austria, and was held prisoner by the Nazis until the Allies freed him in 1945. He was born in Italy, and became a United States citizen in 1956. GABRIEL A. ALMOND

SCHUYLER, *SKY lur*, **PHILIP JOHN** (1733-1804), was an American soldier and statesman. At the start of the Revolutionary War in 1775, he was a delegate to the Continental Congress. After the battle of Bunker Hill, he was appointed a major general in the Continental Army.

In 1777, British forces under Generals John Burgoyne and Sir Henry Clinton, and Colonel Barry St. Leger converged on Albany, N.Y., from three directions. Schuyler delayed Burgoyne's advance by felling trees across the road, contributing to General Horatio Gates' famous victory over Burgoyne at Saratoga. From 1789 to 1791 and in 1797 and 1798, Schuyler served as a United States senator from New York. He was born in Albany, N.Y. IAN C. C. GRAHAM

SCHUYLKILL RIVER, *SKOOL kil*, is an important river in Pennsylvania. It rises in Schuylkill County and flows southeastward for about 131 miles (211 kilometers) before it empties into the Delaware River at Philadelphia. The Schuylkill furnishes power, and part of Philadelphia's water supply. Coal barges use the river, which has been improved by dams and locks.

SCHWA. See PHONETICS (An International Phonetic Alphabet).

SCHWAB, CHARLES MICHAEL (1862-1939), was a founder and president of both the United States Steel Corporation and the Bethlehem Steel Corporation. He started as an engineer's stake driver with the Carnegie Company. He rose rapidly, and became the first president of U.S. Steel in 1901. Resigning in 1903, he took

control of Bethlehem Steel Corporation and directed its growth in shipbuilding, munitions, and allied fields (see BETHLEHEM STEEL CORPORATION). He was president of the American Iron and Steel Institute. Schwab was born in Williamsburg, Pa. W. H. BAUGHN

SCHWANN, THEODOR. See BIOLOGY (The 1800's).

SCHWARZ, BERTHOLD. See GUNPOWDER (History).

SCHWARZKOPF, *SHVAHRTS kawf*, **ELISABETH** (1915-), a lyric soprano, won great success in the 1940's and 1950's as a concert and opera singer. She sang at the Salzburg, Bayreuth, and other important festivals. She was born near Poznan, Poland. She studied at the Berlin Hochschule für Musik and in England. Miss Schwarzkopf sang her first operatic role in Richard Wagner's *Parsifal* at Charlottenburg, Germany, on Easter Sunday in 1938. She made her American debut in a song recital at Town Hall, New York City, in 1953. In 1955, she made her American opera debut in San Francisco. SCOTT GOLDTHWAITE

SCHWARZWALD. See BLACK FOREST.

SCHWEITZER, *SHVY tsur*, **ALBERT** (1875-1965), was a brilliant German philosopher, physician, musician, clergyman, missionary, and writer on theology. His accomplishments in any one of these fields could be regarded as a full life's work for one man.

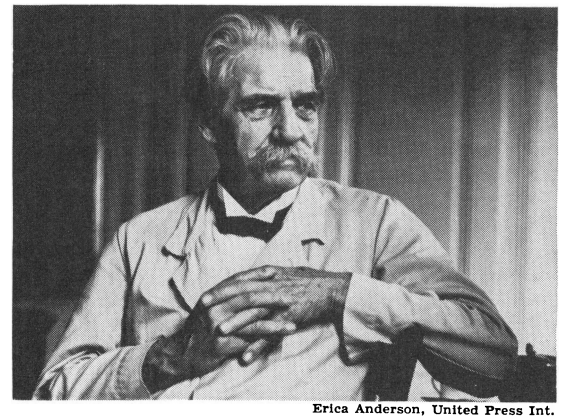
Schweitzer has been called one of the greatest Christians of his time. Early in his career, he based his philosophy on what he called "reverence for life" and on a deep feeling of obligation to serve his fellow man through thought and action. Schweitzer's many years of work as a humanitarian won for him the 1952 Nobel peace prize.

His Life. Schweitzer was born on Jan. 14, 1875, at Kaysersberg, Alsace, and was educated in both France and Germany. At the age of 21, he decided to spend his next nine years in science, music, and preaching, and then to devote the rest of his life to serving humanity directly. Before he was 30, he had won an international reputation as a writer on theology, as an organist and authority on organ building, as an interpreter of the works of Johann Sebastian Bach, and as an authority on Bach's life.

In 1902, Schweitzer became principal of St. Thomas Theological College at the University of Strasbourg. He was inspired to become a medical missionary, and studied medicine from 1905 to 1913 at the university. He raised money for a hospital at Lambaréné, French Equatorial Africa (now Gabon), from his parishioners and by giving concerts for the Paris Bach Society, which he had helped found. In 1913, he began serving at Lambaréné. His first consulting room at his jungle hospital was a chicken coop. Over the years, he built a large hospital and a medical station where thousands of Africans were treated yearly. He used his $33,000 Nobel prize money to expand the hospital and set up a leper colony.

His Books. Schweitzer continued to write on other subjects while in Africa. He completed in 1923 the first two volumes of his monumental work *The Philosophy of Civilization*. These books are *The Decay and Restoration of Civilization* and *Civilization and Ethics*. His other works include *The Quest of the Historical Jesus* (1906), *Out of My Life and Thought* (1931), and *From My African Notebook* (1939).

Schweitzer visited the United States in 1949 to speak at the Goethe Bicentennial Convocation at Aspen, Colo.



Erica Anderson, United Press Int.

Albert Schweitzer, a man of many accomplishments, even designed all of the buildings in his hospital and leper colony.

In 1955, Queen Elizabeth II conferred Great Britain's highest civilian award, the Order of Merit, on Schweitzer. In 1957, Schweitzer went on record as opposing further atomic weapons tests because of the danger of radioactive fallout to mankind. DAVID EWEN

See also GABON (picture).

SCHWENKFELDERS, *SHVENGK fel derz*, is the name of one of the groups of people who went to North America for religious freedom. In 1734, 34 families arrived in North America from Silesia, Germany. Others followed two years later, and organized a settlement in Montgomery and Berks counties in Pennsylvania. The colonists founded an independent denomination in 1782. They named their group in honor of Kaspar Schwenkfeld (1489-1561), a German religious reformer. They have simple church services. The Schwenkfelders have approximately 2,200 members, and five churches in Pennsylvania. WILBUR C. KRIEBEL

SCHWINGER, JULIAN SEYMOUR (1918-), of the United States, shared the 1965 Nobel prize in physics with Richard P. Feynman and Sin-itiro Tomonaga. Working independently, the three men developed an improved theory of quantum electrodynamics in the late 1940's. *Quantum electrodynamics* is the study of the interaction between electrons and electromagnetic radiation. The theory enables scientists to predict accurately the effects of electrically charged particles on each other in a radiation field. Schwinger was born in New York City. He earned A.B. and Ph.D. degrees from Columbia University. He joined the faculty at Harvard University in 1945. R. T. ELLICKSON

SCHWYZ. See SWITZERLAND (History).

SCIATICA, *sy AT ih kuh*, is an inflammation of the *sciatic nerve*. This large nerve runs down the back of each thigh. It originates at the lower end of the spinal cord and runs downward into each leg. It is one of the longest nerves in the body and is strong enough to suspend 400 pounds (180 kilograms). When it becomes injured, inflamed, or infected, it may cause severe pain in the back of the thighs and the legs. In severe cases, sciatica can cause loss of leg reflexes or the wasting of muscles in one or both calves. Treatment includes medications to stop pain, bed rest on a hard board, stretching the leg with traction, vitamin preparations, and other physical therapy. LOUIS D. BOSHES

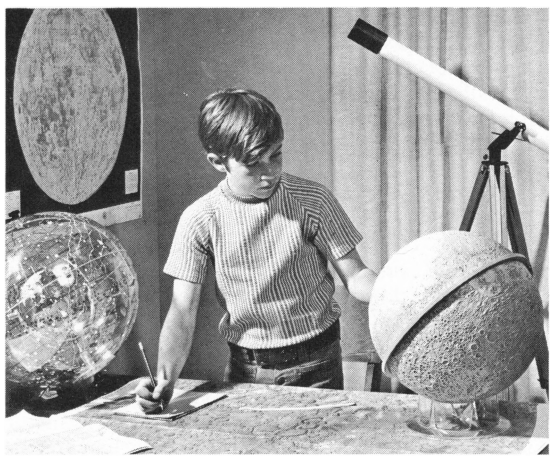
Suzanne Szasz

Biology Is the Study of Living Things. These students and their teacher are studying a turtle during their science class to learn about different kinds of reptiles.

SCIENCE

SCIENCE covers the broad field of human knowledge concerned with facts held together by *principles* (rules). Scientists discover and test these facts and principles by the *scientific method*, an orderly system of solving problems. Scientists feel that any subject which man can study by using the scientific method and other special rules of thinking may be called a science.

The sciences include: (1) *mathematics* and *logic;* (2) the *physical sciences*, such as physics and chemistry; (3) the *biological sciences*, such as botany and zoology, and (4) the *social sciences*, such as sociology and anthropology.



WORLD BOOK photo

Astronomy investigates the mysteries of the universe. It deals with the sun, moon, planets, stars, and other objects that occur throughout the enormous reaches of space.

Scientific study may be divided between pure science and applied science. *Pure science* summarizes and explains the facts and principles discovered about the universe and its inhabitants. *Applied science* uses these scientific facts and principles to make things that are useful to man.

Both pure science and applied science are necessary to bring the benefits of scientific research to mankind. Most people know more about applied science than about pure science, because they come into contact with the achievements of applied science.

The growth of civilization depends on progress and change brought about by scientific discoveries and their use. The military power and peacetime standard of living of modern nations are closely linked with the ability of their scientists to make new discoveries and learn how to use them.

Science in Our Daily Lives

Science is important to everyone. Science has given the world such communication devices as the telephone, radio, and television. It has revolutionized transportation by means of the railroad, automobile, airplane, and rocket. It has made it possible for people to live longer through medical discoveries. Science brought about the Industrial Revolution and made possible the mass production of many products. The armed forces use weapons based on scientific knowledge.

In the Home, scientific progress has made life easier and more pleasant. A housewife once had to spend almost all her time washing and sewing clothes, cooking and preserving food, cleaning house, and tending fires. Science has provided electric energy to run washing machines, sewing machines, refrigerators, heating equipment, and air conditioners. Electric light has replaced the candles, oil lamps, and gas flames that once lighted homes. Frozen foods and automatic stoves make the

preparation of meals more convenient. Detergents have made cleaning and washing easier. These and other advances have given the housewife more time for recreation and community activities.

In Agriculture, science has revolutionized the raising of crops and livestock. In colonial times, about 90 of every 100 Americans lived on farms. Today, only about 5 of 100 work in agriculture. This reduction in the number of persons needed to produce food was achieved largely through scientific advances. Years ago, a farmer could keep only about four horses at work at one time. Today, a tractor provides the power of 50 or more horses. Milking machines and other electric machinery do many farm chores automatically. Scientists working in agriculture have developed new types of grain that both resist plant diseases and produce larger yields. New fertilizers have increased the productivity of the soil. Scientifically designed irrigation systems have made the farmer less dependent on the weather. See AGRICULTURE (How Science Helps Agriculture).

In Manufacturing. Science has enabled manufacturing to move from the home and small shop to the factory. It has also given man the wonders of mass production and automation.

One of the chief advances made in manufacturing has been the development of new sources of power to run machines. In the late 1700's, steam power replaced muscle power. One steam engine could run many large machines. This enabled skilled craftsmen to produce more goods, because they did not get so tired operating their machines. The electric motor, developed in the early 1900's, cost less and was more convenient than the steam engine. Electricity soon largely replaced steam as a source of industrial power.

Also during the early 1900's, scientists and engineers found ways to make large numbers of parts identical in size. This made possible the assembly line, the key to mass production. Developments in electronics resulted in machines that can receive and give instructions. These "electronic brains" can be put in charge of other machines that produce goods automatically.

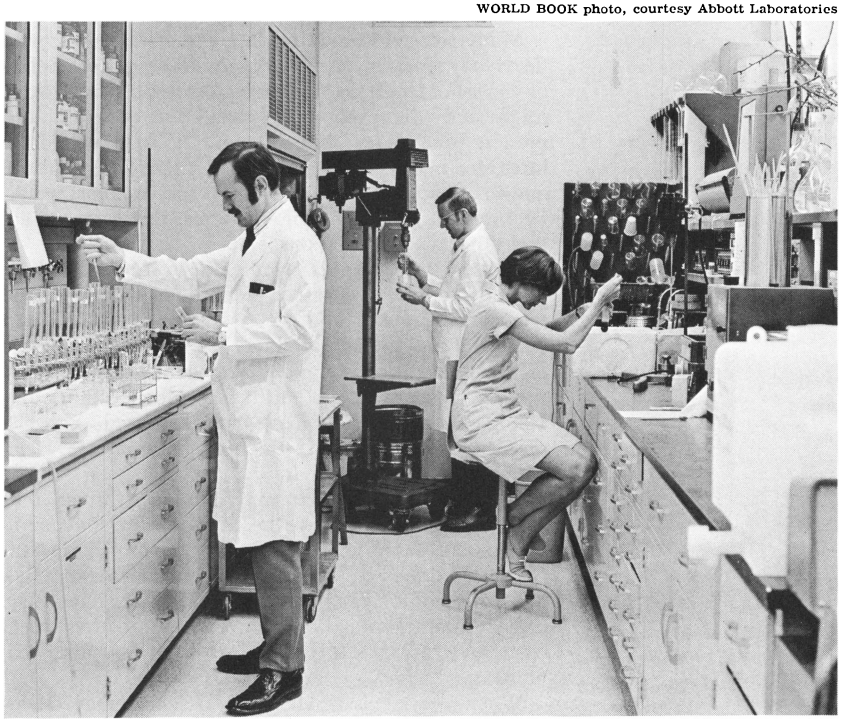
Without scientific discoveries, many modern factories would not exist. New developments in science lead to new products that in turn create millions of jobs. These include jobs in industries that make drugs, automobiles, chemicals, electronic equipment, and synthetic fibers—all the result of scientific discovery. See MANUFACTURING (How Science Helps Manufacturing).

In Medicine, science has given man a longer, healthier life. As a result of advances in preventing and curing disease, a person born in 1965 can expect to live almost 30 years longer than a person born in 1865.

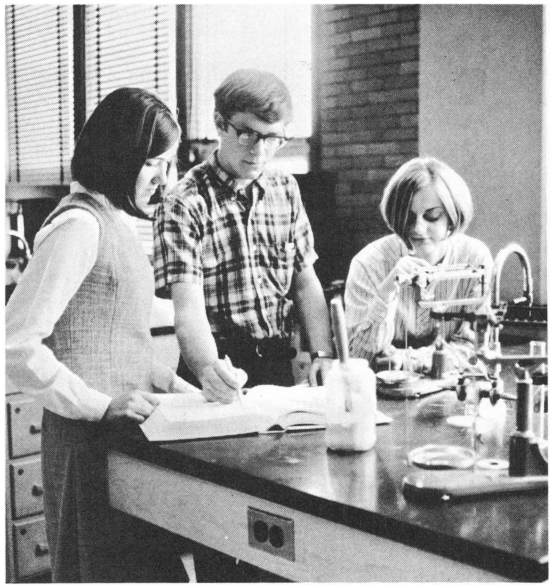
One of the first great developments in the fight against disease took place in 1796, when Edward Jenner used scientific methods to discover a vaccine that could prevent smallpox. In the late 1800's, Louis Pasteur and Robert Koch found that germs cause many diseases and infections. Joseph Lister, influenced by Pasteur's work, developed the method of antiseptic surgery during the same period. His work made operations safer. The development of sulfa drugs and penicillin and other antibiotics in the 1930's and 1940's gave doctors new tools to cure diseases. Jonas Salk reduced the scourge of infantile paralysis when he produced the first polio vaccine in the 1950's. The development of atomic energy gave doctors radioisotopes with which to investigate and cure a number of diseases.

Studies in physiology and anatomy help surgeons perform new operations. They can repair damaged hearts, remove diseased tissues, and relieve continuous

WORLD BOOK photo, courtesy Abbott Laboratories



Scientists in a medical research laboratory conduct studies of the cause and prevention of disease. Many kinds of delicate equipment aid the researchers in their experiments.



Gerry Souter, Van Cleve Photography

Physics Students in a high school laboratory perform an experiment with a scale and weights to learn about density, mass, and other properties of matter. Physics deals with matter and energy—from fragments of atoms to the entire universe.

pain. Work in nutrition helps doctors tell us what foods we should eat to keep well. Research in basic science has helped in treating patients suffering from diabetes and other diseases of the glands.

In the Community, science plays a larger part than most persons realize. Scientists look into almost every daily activity in order to improve the way we live. They study the family to learn the causes of divorce and other social problems. Other research has revealed how slum conditions breed crime. Social scientists help plan schools so that they can best serve the interests of the community. Political scientists suggest ways to improve government.

Scientific methods that determine and analyze public opinion have a great effect on community life. Public-opinion polls aid advertising men in selling products, help television companies in planning programs, and guide candidates for office in conducting their campaigns.

Science also plays an important part in the business life of a community. Research in economics gives bankers and other businessmen ways to predict the ups and downs of business activity. Manufacturers use electronic computers to predict how much of their products they can expect to sell. This helps them plan how much to produce and how many employees to hire.

In War, science has given man terrible new weapons. A guided missile carrying a hydrogen bomb can destroy a city of 10,000 persons. Atomic submarines can cruise beneath the sea for months without coming to the surface. Drops of germs placed in public water supplies could make thousands of persons ill. Nerve gases can cause paralysis and death.

But the same atomic reactor that powers a submarine can propel a merchant ship. Knowledge about the effects of deadly radiation produced by atomic bombs helps cure disease. Even knowledge of nerve gases promises to relieve the suffering of the sick. The same rocket that sends a guided missile through the air can launch an artificial satellite and send instruments to outer space to help man learn more about the universe. The jet engine that powers a bomber can power a giant passenger plane. Scientific discoveries can either help or hurt man. It is up to the people of the world to choose how to use them.

National Science Foundation

Biology Students use microscopes to study the tiny organisms that live in pond water. Biologists study all living things—animals and plants—to discover why organisms behave as they do.

The Branches of Science

Many areas of science overlap, and workers in several fields may study the same problem from different points of view. For example, a psychologist and a physiologist might study the reactions of a man under the conditions present in a space ship. The physiologist would be interested in any changes in the heart rate or respiration, and in other physical reactions. The psychologist would be interested in any hallucinations, errors in seeing, and other mental reactions.

Because the sciences overlap in some areas, it is difficult to make clear-cut definitions of where one science begins and another ends. For example, both chemistry and physics are involved in studying atomic reactions. Both paleontology and geology may study the age of rocks in the earth. In general, the various biological sciences are more closely related than the physical sciences. The distinctions between the social sciences are even less clear.

In some cases, sciences may overlap so much that *interdisciplinary* fields have been established that combine parts of two or more sciences. For example, physical chemistry draws on both physics and chemistry. Biochemistry combines physiology and organic chemistry. Other interdisciplinary fields include mathematical economics, social psychology, astrophysics, and economic geography.

When viewed as a whole, the sciences may be ar-

ranged into four main groups: (1) mathematics and logic, (2) the physical sciences, (3) the biological sciences, and (4) the social sciences. Other groupings are sometimes made. For instance, parts of biology, psychology, and anthropology may be grouped as the *behavioral sciences*. Geology, meteorology, oceanography, and astronomy may be grouped as *earth sciences*.

Mathematics and Logic. Some persons do not consider mathematics and logic as sciences. But these fields of knowledge are such valuable tools for science that we cannot ignore them. Man's earliest questions were concerned with *how many?* and *what belongs together?* He struggled to count, to classify, to think systematically, and to describe exactly. Mathematics and logic developed as tools that helped in these struggles. Scientists generally feel more certain of their results if they can express them in terms of mathematics. Scientists in many areas make mathematical and statistical analyses of their observations.

The state of development of a science is indicated by the use it makes of mathematics. A science seems to begin with simple mathematics to measure, then works toward more complex mathematics to explain. Most sciences start by naming and describing events. The social sciences are now in this position. Then the scientists try to find explanations, or principles, that hold true throughout the whole group of related sciences. The biological sciences are working on this. After developing satisfactory theories, the scientists study the basic problems of the field. For example, physical scientists do this by studying the nature of the atom. They hope to write mathematical equations and rules of logic to predict the atom's behavior. See MATHEMATICS; LOGIC.

The Physical Sciences are concerned mainly with the nature of the universe. They study tiny atoms and vast galaxies. They also study the earth and the physical events that take place on it. Physical sciences include astronomy, chemistry, geology, meteorology, and physics.

Astronomy is the study of the heavenly bodies and their motion. Astronomers have discovered and classified stars, planets, and distant galaxies. They try to learn why stars blow up, and what space and the interior of the sun are like. Much remains to be known about the millions of objects that exist far out in space. See ASTRONOMY.

Chemistry studies materials found on the earth to determine their atomic and molecular structure and the changes that occur in them. Chemists learn to take molecules apart and put them together in new ways. Some chemists analyze substances to determine what elements and compounds make them up. Chemists in industry work to develop better textiles, paper, rubber, plastics, drugs, metals, and other products. *Chemurgy* involves the use of farm and forest products as raw materials for chemical manufacturing. *Organic* chemistry is the study of compounds containing the element carbon, and *inorganic* chemistry concerns all other compounds. *Physical* chemistry undertakes to explain why and how chemical reactions take place. See CHEMISTRY.

Geology studies the shape and structure of the earth and how the earth has changed during its history. Geologists learn how mountains rise up and are worn down, and how rivers and glaciers cut deep valleys out of the earth. They study the location of coal, petroleum, and other minerals beneath the surface of the earth. Geologists have named and classified rocks and minerals. They are concerned with the age of rocks, and with events that occurred millions of years ago and changed the contours of the earth's surface. Branches of geology include *petrology*, the study of rocks; *mineralogy*, the study of minerals; and *seismology*, the study of earthquakes. See GEOLOGY.

Meteorology is the study of weather and the air, or atmosphere. Its chief problem involves predicting the weather. Many meteorologists study the stratosphere, or upper atmosphere, above the highest clouds. They try to learn how conditions there affect weather at the earth's surface. They also want to know what conditions will be met in space travel. See METEOROLOGY.

Physics is concerned with matter and energy. Physicists study mechanics, heat, light, sound, electricity and magnetism, and the properties of matter. Energy and power of all kinds fall within the scope of physics. This science helps engineers design methods to get energy from one place to another. In *atomic* and *nuclear physics*, scientists study the properties of atoms and their nuclei. They search for new ways to control and use the energy of the atom. Other important areas of physics include *aerodynamics*, the study of the motion of air and the forces acting on objects in air; *electronics*, the study of the behavior of electrons; and *solid state physics*, the study of the properties of solids. See PHYSICS.

The Biological Sciences, or life sciences, involve the study of living organisms and their activities. Biological sciences include botany, zoology, paleontology, and psychology. See BIOLOGY.

Botany and Zoology. Botany, the study of plants, and zoology, the study of animals, are concerned with collecting, naming, classifying, examining, and describing living things. Biologists do not merely describe how living things look and act. They try to learn *how* and *why* organisms act as they do. Plants and animals have many characteristics in common, so botany and zoology may be combined as *biology*.

Botany and zoology may be divided into several main fields, each of which can be further subdivided. For example, *morphology*, the study of the structure of organisms, includes *anatomy*, the study of structures of living things; *histology*, the study of tissues; *cytology*, the study of cells; and *embryology*, the study of the development of organisms. *Taxonomy* involves the classification of living things. *Physiology* studies how the bodies of plants and animals function. Medical scientists often work in the area of physiology to study what happens when the body does not function properly. Other areas of biology include *genetics*, the study of heredity, and *ecology*, the study of the relation of organisms to their environment. Some botanists and zoologists specialize in only certain kinds of plants or animals. For example, *bacteriology* is the study of bacteria, and *ornithology* is the study of birds. See BOTANY; ZOOLOGY.

Paleontology is the study of prehistoric plants and animals. Paleontologists investigate *fossils*, or the remains of prehistoric organisms that have been preserved in rocks. They work with geologists to re-create a picture of the earth in prehistoric times. They have found evidence of the gradual change in the form of

animals and plants throughout the earth's history. See PALEONTOLOGY.

Psychology is concerned with the behavior of man and animals. Psychologists study how the nerves and the brain work. They may investigate how animals react to certain situations, or how children learn. They try to find the effects conditions in the body have on various mental reactions. They may work with medical scientists to study the causes of mental and nervous diseases. Some psychologists study the behavior of people in groups, and work in areas similar to those covered by some of the social sciences. See PSYCHOLOGY.

The Social Sciences are concerned with the study of man and society. This is a difficult area to investigate scientifically. Man is an individual who decides what he will do. Usually, he does not act in exactly the same way twice. Not many persons will take part in a large social experiment. So social scientists must find most experimental situations by accident. It is hard for them to carry on precise research. Social scientists use observations, logic, and statistics to arrive at conclusions. See SOCIAL SCIENCE.

Anthropology studies different groups of people. *Social anthropology* is particularly concerned with the development of the various customs and habits of a culture. Anthropologists have made only a few scientific studies of different cultural groups. *Physical anthropology* deals with the development of man's personal characteristics, including his body build and mental traits. It also involves the problem of the evolution of man, and the structure of his ancestors. In this area, anthropologists work closely with paleontologists. *Archaeology* deals with the way ancient men lived. The archaeologist studies the objects made by these people. See ANTHROPOLOGY.

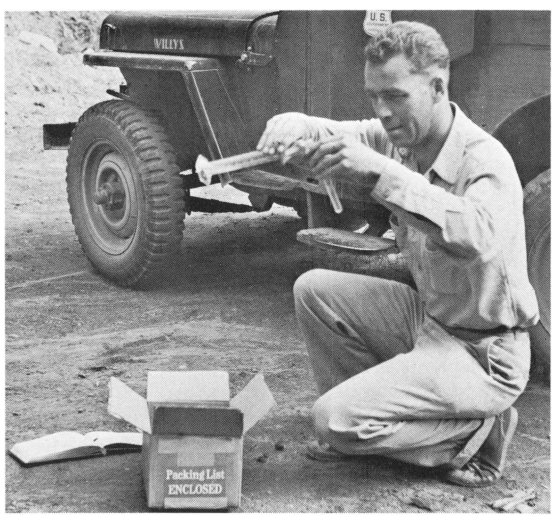
Economics seeks to learn how groups of people use various resources to satisfy their wants and needs. Economists try to predict business trends and the demand for products. They investigate the problems of management and labor. They also try to find how economic systems work, and which ones work best. Economists use computers and statistical analysis in their studies. See ECONOMICS.

Geography studies the use of the physical earth and the living things it supports. Geographers often furnish information needed by economists to make predictions about an area. They study the mineral and water resources needed for development of cities. They try to learn how people adapt to life in various climates. Areas of geography include *physiogeography*, the study of land forms; *oceanography*, the study of waves, tides, currents, and depths of the oceans; and *biogeography*, the study of how living things affect the earth. See GEOGRAPHY.

Linguistics, or philology, involves the similarities and differences between the languages of people in various parts of the world. Linguists try to learn how and why languages change. Some of these experts work on the problem of whether a single language can be developed for all mankind. See LINGUISTICS.

Political Science is chiefly the study of government. Political scientists study customs and laws relating to governments, and try to find out what kind of government benefits the individual most. They also investigate and measure public opinion. See POLITICAL SCIENCE.

Sociology deals with the relation of individuals to the group, and of one group to another. It studies changes in the size and organization of the family and other groups. Sociologists investigate the effect of automation, atomic energy, and high-speed communication on society. See SOCIOLOGY.



U.S. Geological Survey

A Geologist Studies Mineral Samples. Geologists perform many kinds of tests to discover valuable mineral deposits.

How Scientists Work

A scientist is interested mainly in events that can happen again. By repeating an experiment, a measurement, or an observation, a scientist helps find the cause of an event. The scientist may change one part of the experiment slightly when repeating it. What happens to the result of the experiment helps him discover more about how the whole experiment works. If other scientists are to believe what one scientist finds out, the experiment must be so designed that they can repeat it and get the same result.

When a scientist discovers a truth or fact through observations or experiments, he usually makes a written record of it and publishes his discovery. A large number of related facts may be organized to form a scientific principle, sometimes called a *conceptual structure*. The principles help scientists search for and find new facts and principles. The new ideas are linked with the old to make science an organized body of knowledge.

Scientists study a great range of facts and events. For example, a physicist may try to find ways to make atomic energy work for man. A chemist may try to produce new plastics to make life easier. A physician seeks ways to make man healthier. Biologists study how plants and animals grow. The psychologist is interested in how children learn. Scientists try to discover what happens, how it happens, and why it happens.

Although scientists can study many objects and events, there are many things they cannot test. A scientist cannot measure a mother's love for her children. He cannot measure the difference between good and evil. There is no way to tell scientifically what feeling an artist expresses in a painting. Such information has not been scientifically observed and measured.

The Scientific Method is a way of thinking about problems and solving them. The general rules used today were worked out by many men during hundreds of years. Scientists find it difficult to tell in what order they actually use the steps of the scientific method. The human mind probably does not actually solve problems in a systematic fashion. But, after the problem is solved, the scientist can use the scientific method to explain the problem and its solution in an orderly way. The formal plan has at least five check points: (1) stating the problem, (2) forming the hypothesis, (3) observing and experimenting, (4) interpreting data, and (5) drawing conclusions.

Stating the Problem. The scientific method is not hard to use. Anyone who is curious about nature can use it to try to find answers. For example, a student notices that dew is the same thing as rain but there is less of it. He states the problem by wondering whether there is any connection between the rain, the dew, and the amount of each.

Forming the Hypothesis. In forming a possible explanation, or hypothesis, the student considers what he knows of the problem. Both dew and rain are water. Where did the water come from? There are not always clouds when there is dew. Sometimes it rains when it is warm, but it is usually cool when there is dew. Fog leaves water on the ground like dew. From an airplane, a cloud looks like fog. The hypothesis might be that water is carried in the air and condenses into drops when the temperature falls.

Observing and Experimenting. The student used observation in stating the problem and in forming the hypothesis. An experiment might consist of placing an ice-filled metal pitcher above a teakettle standing on a stove. A foggy cloud appears above the teakettle. Part of this cloud forms drops of water on the pitcher. A piece of warm, moist grass sod placed under the pitcher will soon have drops of water on top of it.

Interpreting the Data. In the experiment, the student realizes, the top of the grass gets colder than the bottom, and the water condenses out of the air onto it. The data of the experiment have been interpreted. Dew and rain have the same source. Water can come out of the air.

Drawing Conclusions. The conclusion might be that dew and rain both come from the air. The experiment showed that water can come from the air. Sometimes it is high in the air, sometimes near the ground. Big drops may fall as rain, or small drops may form and make fog or dew.

Logic and Organization. The scientific method described above involves mainly *inductive* logic. This kind of logic requires repeated observations of an experiment or of an event. From observing many different examples, the scientists can draw a general conclusion. But scientists may also use *deductive* logic. In using deductive logic, a scientist reasons from known scientific principles or rules to draw a conclusion relating to a specific case. The accuracy of a conclusion reached by deductive logic depends on the accuracy of the principles and rules used. See DEDUCTIVE METHOD; INDUCTIVE METHOD.

Another important tool used in science is *classification.* Scientists in all fields try to classify their facts, so that their information will have more meaning. For example, chemists classify the elements into families or groups in the periodic table of elements. The elements in these groups have similar properties. Biologists classify plants and animals to show how the different organisms are related to each other. See CLASSIFICATION.

Scientists also have rules for drawing up theories or hypotheses. A theory should explain, unify, or organize known facts. It should be able to predict the results that scientists have obtained. It should also predict new events and open new areas of research. See RESEARCH.

History

Science began thousands of years before man learned to write. No one knows who first discovered fire, invented the wheel, developed the bow and arrow, or tried to explain the rising and the setting of the sun. But all these events ranked as major advances in

U.S. Dept. of Health, Education, and Welfare

Electronic Computers are used widely in various fields of science. Many scientific problems are so complex that they would require years to solve without the aid of computers.

WORLD BOOK photo

Geology Students learn how the earth was formed and how it changes. They study oceans, rocks, and other parts of the earth.

science. They were among man's first attempts to explain and control the things he saw around him. In general, mathematics was the first of the sciences to develop, followed by the physical sciences, the biological sciences, and the social sciences.

Ancient Civilizations. The Egyptians invented many tools and techniques as early as 3000 B.C. They learned some physiology and surgery while embalming their dead. They developed a practical system of geometry to fix property lines, and had a system of mathematics. The Egyptians also studied the stars, named the constellations, and developed a calendar.

In ancient Babylonia, the people developed a calendar, a system of measurement, and a number system. They also developed the pseudoscience of *astrology*. Astrologers tried to foretell the future by interpreting the different positions of the stars and planets. See ASTROLOGY.

The Chinese civilization developed a little later than the Egyptian and Babylonian cultures. The Chinese developed their own system of writing and mathematics, and made advances in astronomy, chemistry, and medicine. But they had little contact with other civilizations, and did not influence Western science. In India, a number system was developed during the 200's B.C. The Arabs learned this system and later passed it on to the West.

The Aztec, Inca, and Maya Indians of America also had some science. The Maya developed a number system. By the A.D. 600's, they knew more about numbers than the Europeans of that time. They used a highly accurate calendar. The Aztec had a number system and a calendar. The Inca also had a number system. But none of these civilizations contributed to European science.

The Greeks left the largest heritage of science of all the ancient peoples. Hippocrates taught that diseases had natural causes and that the body had the power to repair itself. At that time, about 400 B.C., most men thought that the gods caused illness. Aristotle, one of the greatest Greek philosophers, studied all areas of science. He showed the need for classifying knowledge, and recognized the importance of observation, especially in biology. He developed deductive logic as a means of reaching conclusions. Many of his conclusions were false, because Aristotle based his conclusions on mistaken "common sense" ideas, instead of on experiments.

Thales, Pythagoras, Euclid, and others had perfected geometry by about 300 B.C. During the 200's B.C., a center of Greek learning grew up in Alexandria, Egypt. Most Greek scholars were interested mainly in *metaphysics*, or philosophy (see METAPHYSICS). But a few had an interest in practical affairs. For example, Archimedes performed experiments and learned how the lever works. He studied floating bodies and understood *density*, or weight compared with size. Other Greeks measured the size of the earth with surprising accuracy. They also mapped the stars. Ptolemy, in the A.D. 100's, developed a unified idea of the universe. He thought that the stars, planets, and sun move around the earth.

Our scientific heritage from the Greeks includes their emphasis on the rules of thinking, the need for classifying, and the desirability of explaining events.

The Romans were interested mainly in applied science. They developed advanced techniques of engineering and government. But they did little work in theoretical science.

The Greek anatomist Galen practiced medicine in

U.S. Navy

Oceanography Studies the Sea and its animals and plants. Here, a scientist uses a special bottle to bring up water samples.

Rome during the A.D. 100's. His conclusions on anatomy were based on thoughts rather than on scientific observations, and he had many mistaken ideas. Even so, Galen greatly advanced the anatomical knowledge of his time.

The Middle Ages. By the fall of Rome in A.D. 476, scientific advance had ceased. Alexandria fell to the Arabs in A.D. 642. They discovered and preserved some parts of the great library there. The Arabs learned the decimal number system from the people of India, and helped develop algebra. This knowledge joined other scientific knowledge that the Arabs preserved.

In Europe, scholars were more interested in *theology*, or the study of religion, than in the study of nature. They added little new scientific knowledge. Arabic translations of Greek writings began to reach Europe during the A.D. 1000's. But the interpretation of these writings depended on the theology of the times. In the 1200's, theologians organized the knowledge in the Greek writings to agree with their religious views. Scholars saw no need for direct observation of nature. The writings of Aristotle, Galen, and Ptolemy were considered the truth. To disagree with them was considered heresy, punishable by imprisonment or death.

Some scholars of this time were interested in *alchemy*, a mixture of magic and simple chemistry. They tried to produce gold from less costly metals. By their experiments, they laid the basis for later study in chemistry. Some men learned about botany and pharmacology while trying to find magic herbs to lengthen their lives. But a few men were consciously interested in advancing knowledge in the field of science. One of these was the English monk Roger Bacon, who lived during the 1200's. Bacon criticized the deductive method of obtaining knowledge. He saw the need for experiment, measurement, and mathematics. Bacon was imprisoned because he criticized dependence on accepted authority.

The Renaissance began earlier in art and literature than in science. Many men of the 1400's developed an interest in nature. But most of them turned to the Greek writings, rather than trying to add new knowledge. Few questioned the authority of Aristotle and Ptolemy.

IMPORTANT DATES IN SCIENCE

c. 400 B.C.	Hippocrates taught that diseases have natural, rather than supernatural, causes.
300's B.C.	Aristotle's studies in logic and classification contributed to the foundations of science.
c. 300 B.C.	Euclid formulated basic postulates of deductive geometry.
200's B.C.	Archimedes performed experiments and discovered basic physical principles.
A.D. 100's	Galen laid the foundation for the study of anatomy and physiology.
	Ptolemy developed a theory that the earth is the center of the universe.
c. 1500	Leonardo da Vinci recognized the importance of observation and experimentation in learning. He used experiments to make many discoveries.
1543	Nicolaus Copernicus' theory that the earth and other planets move around the sun laid the background for modern astronomy.
	Andreas Vesalius published a book on the anatomy of man, based on observation.
c. 1600	Galileo emphasized the mathematical interpretation of experiments in science. He discovered many important physical laws.
1609	Johannes Kepler established astronomy as an exact science.
1628	William Harvey published his theory on the circulation of the blood.
1660's	Robert Boyle applied the scientific method to chemistry.
1687	Sir Isaac Newton published the *Principia*, which summarized basic laws of mechanics.
c. 1730	Carolus Linnaeus founded the method of classification of plants and animals.
1774	Joseph Priestley discovered oxygen.
1776	Adam Smith published the first systematic formulation of classical economics.
1777	Antoine Lavoisier explained that when an object burns, it unites with oxygen. His research laid the foundation for modern chemistry.
c. 1796	Edward Jenner discovered a method of vaccination against smallpox.
1803	John Dalton announced the atomic theory.
c. 1830	Charles Lyell founded modern geology.
	Auguste Comte started the study of sociology.
1831	Michael Faraday induced an electric current with a moving magnet.
1839	Matthias Schleiden and Theodor Schwann theorized that all living things are composed of cells.
1858	Charles Darwin advanced his theory of evolution of plants and animals.
1860's	James Clerk Maxwell developed his electromagnetic theory.
1866	Gregor Mendel published his discovery of the laws of heredity.
1869	Dmitri Mendeleev developed the periodic table, classifying elements by their atomic weights and their properties.
c. 1876	Louis Pasteur found that microorganisms cause fermentation and disease.
1879	Wilhelm Wundt founded the first laboratory of experimental psychology.
1882	Robert Koch discovered the bacteria that cause tuberculosis.
1895	Wilhelm K. Roentgen discovered X rays.
1898	Marie and Pierre Curie isolated the element radium.
1900	Max Planck advanced the quantum theory.
c. 1900	Paul Ehrlich originated *chemotherapy*, the treatment of disease with chemicals.
	Sigmund Freud developed psychoanalysis.
1905	Albert Einstein presented his Special Theory of Relativity.
1911	Ernest Rutherford put forth a theory of atomic structure. He recognized that the mass of the atom is located in a nucleus.
1928	Alexander Fleming discovered penicillin.
1938	Otto Hahn and Fritz Strassmann found lightweight atoms, after bombarding uranium with neutrons.
1942	Enrico Fermi and his associates achieved the first successful nuclear chain reaction.
1953	Jonas Salk produced the first effective vaccine against polio. It was released for use in 1955.
1957	Russia launched the first artificial satellite.
1957	Arthur Kornberg grew DNA, the basic chemical of the gene, in a test tube.
1961	Yuri Gagarin of Russia and Alan B. Shepard, Jr., of the United States became the first men to fly in space.
1969	Neil A. Armstrong and Edwin E. Aldrin, Jr., landed on the moon and brought moon rocks and dust back to earth for scientific study.

Leonardo da Vinci, the Italian artist, represented a new type of thinker. In the late 1400's, he studied anatomy by dissecting bodies, rather than by reading what Galen had written. He found that light and sound follow certain rules. But he did not publish his results, and had little influence on the men of his time. The Swiss physician Philippus Paracelsus also observed nature. He found experience and observation more important than the authority of Aristotle and Galen.

The Rebirth of Science began about 1543, with the publication of two books that changed man's ideas about his world and about himself. Nicolaus Copernicus, the Polish astronomer, published *De Revolutionibus Orbium Celestium*, which differed from Ptolemy's view of the solar system. Andreas Vesalius, the Belgian anatomist, published *De Fabrica Corporis Humani*, which described his own anatomical observations, rather than repeating Galen's statements. Both these books were based on observations. Both broke from the old ideas, but kept portions of the Greek influence.

Copernicus' book revolutionized the thinking of many scholars. Before his work, scholars had accepted Ptolemy's view that the earth was the center of the universe. The Greeks viewed the circle as the perfect shape, so Ptolemy thought that the planets moved in circular paths. But, to agree with observations, Ptolemy had to assume a complicated series of motions for each planet. Copernicus saw that if the earth traveled around the sun the explanation required a less complicated arrangement of circles. But it did not predict the motion of all the planets exactly.

Tycho Brahe, the Danish astronomer, made accurate observations of the planets in the late 1500's. Johannes Kepler of Germany used Brahe's observations as a basis to test Copernicus' theory. In 1609, he showed that the theory could explain observed facts if the circular paths of the planets were replaced by elliptical paths. This also made the movements of the planets still simpler. Kepler's discovery marked the start of modern astronomy.

The second important book published in 1543, Vesalius' work on anatomy, showed that Galen had made many mistakes. Vesalius based his work on the observation of actual dissections of bodies. But he used the inaccurate physiology presented by Galen. The final break with tradition came in 1628, when William Harvey of England described the circulation of the blood. His work was based on observation, careful experiments, and simple mathematics. Harvey's work marked the beginning of modern physiology.

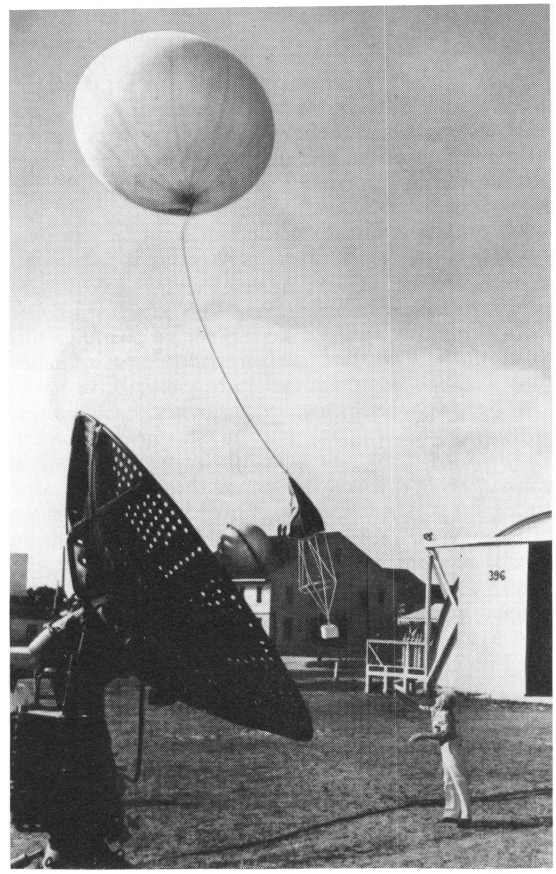
Men began to turn from the established patterns in areas other than astronomy and physiology. In 1600, William Gilbert of England summarized knowledge about electricity and magnetism. He based his work on observation and experiments. Francis Bacon, the English writer, summarized the theory of the experimental method. He also urged the use of the inductive method of reasoning. Robert Boyle introduced the scientific method in chemistry in the 1660's. He defined a chemical element, and proposed theories on the nature of matter.

Galileo and Newton. Galileo, the great Italian physicist of the late 1500's and early 1600's, is recognized as the father of modern experimentation. Galileo recognized the importance of observation at a time when most scientists referred only to "the authorities." In his research, Galileo set up relationships between events, depending on observation and mathematical analysis. He recognized that experimentation can lead to the discovery of new principles. For example, his observations of falling bodies led him to discard Aristotle's laws. After performing many experiments, he was able to set up a new principle. One of Galileo's greatest contributions to science was his recognition of the importance of observation, exact measurement, and planned experiments.

Galileo discovered many principles of physics, particularly in mechanics. He also improved instruments of measurement. In his research with the telescope, he found important evidence supporting Copernicus' view of the universe. See GALILEO.

Sir Isaac Newton of England, in the late 1600's, used the findings of others to develop a unified view of the forces in the universe. His book, the *Principia*, published in 1687, presented a common explanation for many physical events. These included the difficulty of making a heavy object move quickly, the characteristic motion of falling bodies, and the paths followed by the moon and planets.

A number of scientists had described observations and measurements for physical events. Galileo and those following him also performed many experiments, and obtained various measurements. But the measure-



U.S. Army

Studying the Weather is an important part of science. A meteorologist uses a balloon to study the atmosphere.

ments often had little meaning. There were too many of them and they were unrelated. To unite these unrelated observations and measurements, Newton developed a concept that would explain the events. He also set up a mathematical explanation that could predict the measurements accurately. Newton's main idea was *gravitation*. Using this idea, everything fitted together. It not only explained events on earth, but also in the rest of the universe.

Newton demonstrated the application of the rules of the scientific method. He showed their use in making general explanations that covered a wide group of separate events. Without men such as Newton to guide the development of theories in science, the efforts of many workers would be lost in a jumble of isolated facts. Science progresses because its knowledge is *systematized*, or organized, by unifying ideas that explain many events. See NEWTON, SIR ISAAC.

In the 1700's, scientists discovered new chemical substances, including chlorine, oxygen, hydrogen, and carbon dioxide. By 1777, Antoine Lavoisier of France had discovered the true nature of combustion. He showed that burning results from the rapid union of the burning material with oxygen. He also developed the method of describing chemical reactions by equations.

Great advances also occurred in biology during the 1700's. The Swedish scientist Carolus Linnaeus developed the first successful method for naming and classifying plants and animals. This method, with many modifications, is still used today. In 1757, the Swiss physiologist Albrecht von Haller developed systematic physiology by organizing what biologists had learned about respiration, circulation, embryology, and the nervous system.

In the 1800's, physicists carried the work of Newton further. They produced a unified, seemingly complete, view of the laws of nature. James P. Joule of England showed that heat is a form of energy. He also stated the principle of the conservation of energy. This principle states that energy cannot be created or destroyed, but only changed in form.

Michael Faraday of England found in 1831 that a moving magnet can induce an electric current. In the 1860's, James Clerk Maxwell, also of England, used mathematics to describe Faraday's work on electricity and magnetism. Maxwell showed that light and other energy waves are fundamentally the same.

Dmitri Mendeleev of Russia simplified and systematized the description of chemical reactions when he published his periodic table of elements in 1869. This table, which groups elements according to their atomic weights and chemical properties, clarified the relations between the various elements. Other chemists explained the nature of organic compounds, and devised new ways to explain chemical reactions mathematically.

In the 1830's, the British geologist Charles Lyell provided evidence that the earth's surface changed slowly and gradually through millions of years by means of processes that are still continuing. Other geologists had believed that the earth reached its present shape as a result only of great *cataclysms*, or violent changes.

In 1858, Charles R. Darwin presented to biology a unifying idea—the concept of orderly, gradual change, or *evolution*. He presented evidence that plants and animals have changed their characteristics through the ages. Darwin formulated a theory explaining how these changes might take place. This was the idea of natural selection through competition. See EVOLUTION.

Several new sciences had their beginnings during the 1800's. In the mid-1800's, Gregor Mendel, an Austrian monk, discovered basic laws of heredity that laid the foundation for the science of genetics. Louis Pasteur of France started modern microbiology with his studies of fermentation and disease. He found that certain microscopic organisms can produce disease in man and in animals. Many scientists studied the relationship between the physiology of the nervous system and human behavior. In 1879, Wilhelm Wundt founded the first laboratory of experimental psychology in Leipzig, Germany.

The Early 1900's brought revolutionary advances in all fields of science. But perhaps the most dramatic discoveries have been made in the field of physics, especially as a result of atomic research.

In Physics, several discoveries during the late 1800's showed scientists that the picture of the universe as seen by the followers of Newton was not accurate. In 1900, Max Planck of Germany advanced his celebrated quantum theory to explain certain properties of heat energy (see QUANTUM MECHANICS). This theory states that energy is not released continuously, but in units, or bundles, called *quanta*. Albert Einstein extended the quantum theory to light energy in 1905. He showed that light rays are streams of energy units which he called *photons*. That same year, Einstein published his famous Special Theory of Relativity (see RELATIVITY). His theory revised many of Newton's concepts and added new ideas. One of Einstein's most important theories was the possibility that mass could change into energy, as expressed in the formula $E=mc^2$.

Research into the structure of the atom led to the discovery of many atomic particles. Soon after 1910, Ernest Rutherford of New Zealand and Niels Bohr of Denmark presented theories of the internal structure of the atom. Rutherford produced the first nuclear reaction in 1919. He bombarded nitrogen atoms with alpha rays and changed some of them into oxygen. During the late 1930's, Otto Hahn and Fritz Strassmann of Germany, and Lise Meitner and Otto Frisch of Austria developed the possibility of releasing energy by splitting atoms of uranium. Enrico Fermi and his coworkers achieved the first controlled nuclear chain reaction in 1942. Intensive research during World War II led to the development of atomic energy in weapons. After the war, scientists directed research toward perfecting it as a source of power and producing still more powerful weapons. See ATOM (Development of the Atomic Theory); NUCLEAR ENERGY (Development).

Advances in other areas of physics included studies of the properties of matter at extreme temperatures. Research in electricity led to the development of television, electronic computers and factory controls, and other electronic devices. Further work in the area of the quantum theory produced additional knowledge about the nature of the atom and of atomic particles.

In Chemistry, scientists acquired much information about the preparation of new compounds. They developed many plastics, synthetic fibers, and drugs. Linus

Pauling of the United States devised accurate models of the molecular structure of many complex compounds.

In the Biological Sciences, many advances were made during the 1900's. Paul Ehrlich of Germany founded the now-important field of *chemotherapy*, the treatment of diseases with chemicals. In 1928, Alexander Fleming of Great Britain discovered penicillin, the first of many antibiotics used in the battle against disease. In the field of genetics, the work of the Dutch scientist Hugo de Vries led to a greater understanding of heredity. In 1901, he first extensively described *mutations*, or changes in hereditary material (see MUTATION). Scientists later applied statistics to the study of heredity. This work in genetics resulted in the improvement of breeding techniques with plants and animals.

In the Social Sciences, research brought new facts and the development of theories to organize these facts. Great progress has been made in perfecting methods of collecting data and analyzing facts statistically.

The Mid-1900's saw continued progress in all fields of science. Medical science developed the Salk and Sabin polio vaccines and introduced new surgical techniques. Surgeons transplanted organs from one person to another. Physicists discovered new subatomic particles and produced new radioactive elements (see TRANSURANIUM ELEMENTS). Anthropologists made new discoveries about man's remote past. Geneticists grew *deoxyribonucleic acid* (chemicals that play a vital part in heredity, known as DNA) in laboratories (see HEREDITY). The invention of *lasers* (concentrated beams of light) promised great advances in communications, medicine, electronics, and weapons (see LASER).

During the International Geophysical Year (1957-1958), scientists of 66 nations cooperated in special experiments to increase knowledge about the earth and its surroundings. See INTERNATIONAL GEOPHYSICAL YEAR.

The space age opened in 1957, when Russia launched artificial satellites that circled the earth. The United States sent up its first artificial satellite in 1958. In 1961, both nations began sending men into space. Unmanned spacecraft probed interplanetary space, sending back to earth information about nearby planets. In 1969, the first manned craft reached the moon. See SPACE TRAVEL; ROCKET.

Problems of the Future. Despite the great advances made in science, scientists still have many unsolved problems. Physicists have not yet produced the high temperatures needed for controlled atomic fusion reactions. Botanists still do not know exactly how the process of photosynthesis works. Biologists and biochemists have not yet found the answer to the question of how life originated. Astronomers have not yet developed a satisfactory explanation of the origin of the universe. Medical scientists and physiologists do not know the cause or cure of cancer or how to cure the various virus diseases. Paleontologists and geneticists search for still more evidence on the events and processes of evolution of plants and animals. Psychologists do not know all the causes of mental illness.

Careers in Science

Science Education begins in a general way in elementary school. Even in the early grades, students learn the names of many things. They learn to describe, to measure, and to *infer* (draw conclusions). Experiments show how things work. The general ideas of science are used to explain events in nature. For example, children may learn a simple explanation of what causes the differences in the seasons, what makes rain, or what keeps a satellite in the sky. From these general ideas about nature, the students begin to build an understanding of science.

In the later elementary grades, science teaching becomes more formalized. The students receive an understanding of science as a field of knowledge. They learn that science includes many fields, such as biology, chemistry, earth science, and physics. Most of their study is general, covering many areas, but not in a detailed manner.

High School Science and mathematics are more specialized than in elementary school. Most students take a minimum of one year of science. This may be general science, biology, chemistry, earth science, or physics. Many students continue their science education and study more than one field of science. High school science courses help students learn how the scientific method works and how our industrial society uses science. Some students may study the applied sciences, such as aerospace science, agronomy, or specialized shop courses.

Students who plan professional careers in pure and applied science usually take at least two years of natural science and three years of mathematics in high school. High school biology, chemistry, and physics courses show students how scientists obtain and organize knowledge in these fields. Experiments illustrate both what happens and how scientists use logic and inference to study nature. High school science projects provide young people with a chance to be creative, and to apply concepts to fields that interest them. They work individually to perform an investigation, to complete a collection, or to build a model. Working on a science project helps them gain an idea of what scientific research involves. Many students exhibit their projects in science fairs.

Mathematics courses in high school teach mathematical reasoning, and show how to apply it to scientific problems. Algebra, geometry, trigonometry, and other mathematics courses are highly recommended for students interested in scientific careers.

College Science courses appeal chiefly to men and women who plan to become professional scientists. But many college students take some science during the freshman year. Students majoring in biology, chemistry, physics, mathematics, or one of the social sciences take at least four one-year courses in their major subject. The science major also usually takes three years of courses in a related science or in mathematics.

Graduate School. Most students interested in research or in one of the scientific professions take graduate courses after receiving a bachelor's degree. In graduate school, the student studies one or two subjects intensively. He can usually meet the requirements for a master's degree after one year of graduate work. Requirements for the Ph.D. and similar degrees normally take three additional years of graduate study.

On-the-Job Training. A college graduate employed by a large corporation may receive still more training. College provides him with a knowledge of scientific

principles. Industrial training programs may teach him how to apply these principles to the problems of a particular company. The industrial training program serves both to introduce employees to the company, and to help scientific workers keep up to date.

Working in Science is one of the most rewarding careers a young person can choose. There are many job opportunities because science holds such an important place in modern life. For example, industry hires technicians to control the quality of products. Some companies hire persons trained in science as salesmen. Research scientists work on the frontiers of knowledge to discover new facts. Government agencies and some businesses employ environmental specialists. Schools need science teachers.

Research. The scientist in research and development works where knowledge is fresh. He must know his special field well, and be acquainted with related fields of knowledge. He should be creative, dedicated to his work, and interested in exploring and testing new ideas. Team research in large laboratories may have as many as a dozen men and women working under a group leader on different aspects of the same problem. However the researcher must also be able to work individually.

Beginning work in research requires a master's degree. The doctor's degree is desirable for positions of leadership. Generally, industrial work pays better than university, institute, or government employment. Scientific consultants who work independently for manufacturers usually have the highest incomes. For information about the many kinds of scientific research, see RESEARCH (Research in Action).

Teaching. Teaching positions in the science field include serving as science consultant in elementary school, teaching science in high school, and teaching advanced courses in college and graduate school. The qualifications include a mastery of the field and the ability to transmit interest and understanding to others. Most science teachers earn a master's degree before they become established in the profession. A college teacher having a doctor's degree may be promoted. Teaching normally provides time for travel and further study. Some college teachers have both teaching and research assignments.

Technicians. An increasing number of science technicians work in industries and offices. They include computer operators, dietetic assistants, electronic technicians, and medical technicians. A supervising scientist or engineer directs their work. Many of the positions are open to graduates of two-year community colleges. Technicians also work in university, hospital, and institute laboratories.

Other Careers. A great variety of other careers exist in the field of science. These include science writing, abstracting, editing, and reporting; scientific and medical illustrating; science library work; and translation of scientific articles and books. Technical salesmen, trained in science or engineering, call on industries and professional men. Graduates in the social sciences may help administer welfare funds. Naturalists and game-management specialists may work for public parks and forest preserves. Large numbers of students enter such science-related professions as medicine, dentistry, engineering, geriatric care, and dietetics. H. CRAIG SIPE

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Chemistry	Geology	Physics
Chemurgy	Geophysics	Solid State Physics
Dynamics	Mechanics	Statics
Earth Science	Metallurgy	Thermodynamics
Electrochemistry	Meteorology	

THE SOCIAL SCIENCES

Anthropology	Linguistics	Psychology
Economics	Philosophy	Social Science
Geography	Political Science	Sociology

MATHEMATICS AND LOGIC

Biomathematics	Mathematics
Logic	Statistics

ORGANIZATIONS

American Association for the Advancement of Science	Meteorological Society, American
Arts and Sciences, American Academy of	National Academy of Sciences
Future Scientists of America	Royal Institution
International Council of Scientific Unions	Royal Society
	Science Clubs of America
	Sigma Xi

OTHER RELATED ARTICLES

Environmental Pollution	Science Projects
Experimentation, Scientific	Technology
Instrument, Scientific	Vocations (Science Vocations)
Research	

Outline

I. Science in Our Daily Lives
- A. In the Home
- B. In Agriculture
- C. In Manufacturing
- D. In Medicine
- E. In the Community
- F. In War

II. The Branches of Science
- A. Mathematics and Logic
- B. The Physical Sciences
- C. The Biological Sciences
- D. The Social Sciences

III. How Scientists Work
- A. The Scientific Method
- B. Logic and Organization

IV. History

V. Careers in Science

Questions

How does the scientific method work?

What is the difference between inductive and deductive logic? Between pure and applied science?

What were the main contributions of the Greek philosophers to science?

What kinds of problems do social scientists try to solve? What techniques do they use?

What is an interdisciplinary science?

How is mathematics valuable to the various sciences?

In general, what was the order in which the four branches of science developed?

What ancient people left the largest heritage of science?

SCIENCE AND INDUSTRY, MUSEUM OF. See MUSEUM OF SCIENCE AND INDUSTRY.

SCIENCE CLUBS OF AMERICA is an international organization open to boys and girls of all ages who have a hobby or professional interest in science. About 5,000 groups in the United States and other countries are affiliated with it. Each club is sponsored by an interested adult. Science Clubs of America sponsors the International Science and Engineering Fair and the Science Talent Search.

The International Science and Engineering Fair, held in a different city each May, is open to students in the 9th, 10th, 11th, and 12th grades. Representatives come from the finalists chosen at annual regional fairs.

The Science Talent Search for the Westinghouse Science Scholarships and Awards is open to high school seniors in the continental United States. Each applicant must write a report on his science project. His completed entry includes a personal data form and school records filled out by his teachers and principal. Honors are awarded to about 10 per cent of the students. The top 40 go to Washington, D.C., for the five-day, all-expense paid, Science Talent Institute. They are judged there for ten scholarships—one for $10,000, two for $8,000, three for $6,000, and four for $4,000—and 30 cash awards of $250 each.

In an attempt to assist talented science students, State Science Talent Searches are conducted in 42 states and the District of Columbia by special arrangement with Science Clubs of America.

The organization was founded in 1941. It is administered by Science Service with headquarters at 1719 N St., NW, Washington, D.C. 20036.

Critically reviewed by SCIENCE CLUBS OF AMERICA

SCIENCE FICTION is a popular kind of imaginative literature. Its basic themes include space travel, time travel, and marvelous discoveries or inventions. Most modern science fiction stories are set in the future, but some take place in the past or even in the present day. Some are set in another universe. Unlike fantasy, which deals with the impossible, science fiction describes events that could actually occur, according to accepted or possible theories. Some science fiction stories give detailed scientific explanations. Other stories simply thrust the reader into a strange time or place.

Beginnings of science fiction go back to prehistoric myths and tales of fantastic voyages and adventures. In the A.D. 100's, the Greek writer Lucian of Samosata transformed these adventures into science fiction. For example, his *Icaromenippus* and *The True History* describe trips to the moon. Another fictional voyage to the moon occurs in Ludovico Ariosto's *Orlando Furioso* (1532).

The 1600's brought the birth of both modern science and science fiction. Francis Bacon, often called the father of modern science, wrote *The New Atlantis* (1627). This work uses the theme of a marvelous voyage to describe a society based on experimental science and the practical wonders science could create. The German astronomer Johannes Kepler described a trip to the moon in his *Somnium* (published in 1634, after his death). This book was the first science fiction that tried to tell a story with scientific accuracy. The 1600's also produced the first science fiction set in the future—Francis Cheynell's *Aulicus* (1644) and Jacques Guttin's *Epigone, Story of the Future Century* (1659).

As science fiction developed during the 1700's, it produced its first literary masterpiece, *Gulliver's Travels* (1726) by Jonathan Swift. The first story of visitors from other planets was Voltaire's *Micromégas* (1752). The Industrial Revolution caused social revolution and hardship among many people. These elements influenced the Gothic novel, which featured horror, violence, and the supernatural. The chief science fiction work in this field was Mary Shelley's *Frankenstein* (1818). Edgar Allan Poe and Nathaniel Hawthorne developed the science fiction short story. The romance, the main form of American fiction during the 1800's, included elements of science fiction.

By the late 1800's, science fiction had reached its most characteristic modern form in the works of Jules Verne and H. G. Wells. Verne was the first writer to specialize in science fiction. He was responsible for making the general public aware of science fiction as a distinct branch of literature.

The 1900's. Social and political argument, which appeared in much early science fiction, were emphasized even more in the 1900's. Eugene Zamiatin's *We* (1924), written during the Russian civil war, defined a form known as *anti-utopia*. Utopian fiction portrays ideal worlds. Anti-utopian fiction sees these ideal worlds as nightmares. Famous examples include Aldous Huxley's *Brave New World* (1932) and George Orwell's *1984* (1949). A widely read answer to anti-utopian fiction is *Andromeda* (1956), a utopian novel by Ivan Yefremov.

Science fiction predicted the technological and scientific marvels of the atomic and space ages. Karel Čapek coined the word *robot* in his play *R.U.R.* (1921) and discussed the atomic bomb in his novel *Krakatit* (1924). Olaf Stapledon wrote two influential science fiction novels, *Last and First Men* (1931) and *Star Maker* (1937).

In Russia, science fiction began receiving much attention and encouragement as early as the 1920's. In 1928, the famous Russian author Maxim Gorki praised science fiction for displaying "the amazing ability of our thought to look far ahead of actual events."

In the United States, magazines called *pulps* have played the major role in the development of science fiction. Hugo Gernsback founded the first pulp, *Amazing Stories*, in 1926. About 1930, he became the first person to use the term *science fiction*. The early pulp magazines concentrated on scientific marvels, but turned increasingly to major social concerns after John W. Campbell, Jr., became editor of *Astounding Science Fiction* in 1937. Campbell developed a group of writers who dominated the field in the mid-1900's. These writers included Poul Anderson, Isaac Asimov, Hal Clement, L. Sprague de Camp, Lester del Rey, Robert A. Heinlein, and Theodore Sturgeon.

Science fiction gained a wider audience after World War II ended in 1945. Its popularity grew as developments in atomic energy and space exploration showed that much science fiction was more realistic than many people believed. In the 1960's and 1970's, many serious science fiction programs appeared on television. Motion pictures based on science fiction included *Fantastic Voyage* (1966) and *2001: A Space Odyssey* (1968).

Today, many universities offer courses in science fiction. ISAAC ASIMOV

Related Articles in WORLD BOOK include:

Asimov, Isaac	Frankenstein	Swift, Jonathan
Bradbury, Ray	Gulliver's Travels	Utopia
Čapek, Karel	Heinlein, Robert A.	Verne, Jules
Clarke, Arthur C.	Sturgeon, Theodore	Wells, H. G.

SCIENCE PROJECTS are special activities that help students learn about nature and natural laws. Such activities range from simple models and demonstrations to complicated experiments that follow the same methods used by research scientists. Working on a science project encourages the student to take a personal interest in the scientific principle being demonstrated.

A project may be based on a single field of science, such as astronomy, biology, chemistry, geology, meteorology, or physics. Or it may involve several scientific fields. For example, a student might have to use both biology and chemistry to complete a project on environmental pollution.

The time required to do a project depends on how complicated it is. Building a model or preparing a demonstration may take only an evening or two. The completion of a series of experiments may require several months. To get the most out of a project, the student usually prepares a report and an exhibit that summarize the project and what was learned by doing it. Many schools give students the opportunity to exhibit their projects at an event called a *science fair*.

Kinds of Science Projects are as varied as science itself. However, many projects fall into the following categories: (1) building a model, (2) preparing a demonstration, (3) forming a collection, and (4) performing an experiment.

Building a model can help the student understand certain ideas in science. For example, a student can study the parts of an internal combustion engine and how they relate to one another by building a model. Another kind of model shows how scientific equipment works. An example of such a model is a *hygrometer* (humidity measuring device) made from two thermometers and a milk carton. This model is shown in the article on HUMIDITY.

Preparing a demonstration helps the student study a scientific principle or law. For example, the student might set up a demonstration to explain why objects appear to lose weight when placed under water.

Forming a collection helps increase the student's awareness of nature. The student might collect and identify the various kinds of plants and animals found in a field or vacant lot.

Performing an experiment is perhaps the most difficult and most educational type of science project. The student sets up and performs an experiment to confirm or discover natural laws. For example, the student might investigate the effect of colored light on the growth of plants. The project would involve growing plants under different colored lights and measuring the growth of the plants.

Planning and Doing a Science Project. The first step in a project is to develop the idea for it. Many students develop ideas from their own personal interest in such fields as ecology, electronics, or medical research. Suggestions for projects may be found in books and magazines devoted to science. Several WORLD BOOK articles include ideas for science projects. See the list of *Related Articles* at the end of this article.

The idea for a project should match the student's ability to do it. Most elementary school students can handle the construction of a model or a demonstration project. But experiments that require abstract thinking and detailed work are best suited to high school students. Teachers can help identify projects suited to a student's abilities.

After selecting an idea, the student may need to do some background reading in textbooks and reference books. This reading helps the student decide how to go about the project. The student should concentrate on basic principles and ideas to avoid becoming confused by too much detail and overly complicated equipment. Teachers may have helpful suggestions about how to proceed and where to find needed equipment.

Before beginning any project involving *vertebrate* animals (animals with a backbone), the student must check on state laws regarding such animals. Most states have laws that specify how vertebrate animals may be used in a project. A project using plants or *invertebrate* animals (animals without a backbone) can provide just as much information about living things as one using vertebrate animals. The experimenter should avoid using certain materials in projects involving animals. Anesthetic drugs or microbes capable of causing disease have no place in a science project.

The experimenter should plan to take the time necessary to do a project well. This means starting the project well in advance of the day it must be completed. A student preparing a demonstration should take time to practice it until he feels comfortable giving it and can answer questions about it. Experiments should be carefully planned, performed, and repeated, to make certain they support the scientific conclusions reached by the experimenter. For more information on experimentation, see EXPERIMENTATION, SCIENTIFIC.

Keeping accurate records helps the experimenter prepare a report on his project. The report tells (1) what the student expected to learn, (2) how the project was carried out, (3) the results obtained, and (4) the conclusions reached.

Preparing an Exhibit. An exhibit, along with a report, helps explain the science project. Most science fair exhibits feature a poster with a brief explanation of the project printed on it. The poster may also display diagrams and charts. Collections should be neatly arranged and labeled. The equipment used for experiments can be set up to show how tests were performed. Advanced students sometimes use tape recordings, slides, or motion-picture film to make their exhibit more attractive and interesting. GEORGE J. PALLRAND

Related Articles. The following articles include special WORLD BOOK Science Projects:

Air	Electric Motor	Microscope
Antibiotic	Electricity	Nutrition
Astronomy	Energy	Physics
Atom	Eye	Radio
Biology	Heredity	Seed
Chemistry	Leaf	Skeleton
Color	Light	Waves
Dam	Magnet and Magnetism	Weather
Ear	Metal	Zoology

SCIENTIFIC CLASSIFICATION. See CLASSIFICATION.

SCIENTIFIC INSTRUMENT. See INSTRUMENT, SCIENTIFIC.

SCIENTIFIC METHOD. See SCIENCE (The Scientific Method); AGE OF REASON.

SCIENTIFIC SATELLITE. See SPACE TRAVEL (Scientific Satellites).

SCILLY ISLANDS, *SIHL ih,* lie in the Atlantic Ocean off the coast of Cornwall, England, about 25 miles (40 kilometers) from Land's End. The islands belong to Great Britain. They are the first land that travelers see as they approach England from New York City.

The group has about 150 islands, but only five of them are important. The capital of the island group is Hugh Town, which stands on Saint Mary's Island.

The islands cover an area of 6 square miles (16 square kilometers), and have a population of about 2,000. They are wild and colorful. Because the climate is mild, they have become a popular tourist center. The islands also supply flowers, vegetables, and fish to British markets. FREDERICK G. MARCHAM

SCIMITAR. See SWORD.

SCINTILLATION COUNTER. See GEIGER COUNTER.

SCINTILLOSCOPE. See SPINTHARISCOPE.

SCION, a variant of CION. See GRAFTING (plants).

SCIOTO RIVER, *sy OH toh,* a branch of the Ohio River, flows 237 miles (381 kilometers) and drains the rich farming region of central Ohio. It rises in west-central Ohio, flows eastward, and then turns south. It empties into the Ohio River at Portsmouth.

SCIPIO, *SIHP ih oh,* was the name of a branch of the great Roman family, the Cornelii. Two of its members are called AFRICANUS MAJOR and AFRICANUS MINOR.

Publius Cornelius Scipio, AFRICANUS MAJOR (236?-184? B.C.) was the Roman general who invaded Africa and defeated Hannibal of Carthage (see HANNIBAL). He is known as AFRICANUS because of this victory. During the Second Punic War, Scipio took Spain away from the Carthaginians. He then invaded Africa, and Hannibal was recalled from Italy to fight Scipio. In 202 B.C., Scipio defeated Hannibal at Zama, the last battle of the Second Punic War. See PUNIC WARS.

Scipio's political party dominated Rome for the next 10 years, but Cato the Censor and other Roman senators were suspicious of his popular appeal. Scipio retired from public life when his brother Lucius was convicted of dishonest practices.

Publius Cornelius Scipio Aemilianus, AFRICANUS MINOR (185-129 B.C.) was the son of Lucius Aemilius Paullus, a Roman statesman, and by adoption the grandson of AFRICANUS MAJOR. Scipio Aemilianus is known as AFRICANUS because of his victories in Africa. He was *consul* (chief government official) in 147 B.C., and directed the siege which led to the destruction of Carthage during the Third Punic War. As consul again in 134 B.C., he destroyed Numantia in Spain.

Scipio was a political leader. He also did much to spread Greek learning in Rome, and led a group of intellectuals known as the *Scipionic Circle.* Its members included the dramatist Terence, the Greek historian Polybius, the Greek philosopher Panaetius, and Rome's first great satirist Lucilius. HENRY C. BOREN

SCISSORBILL. See SKIMMER.

SCISSORS, *SIHZ uhrz.* A pair of scissors is really two knife blades joined together to form a double lever. Each blade operates as a lever of the first class (see LEVER). A pin or bolt holds the blades together, and acts as their common fulcrum. The lever action starts by squeezing the open scissors handles together. This applies pressure against both sides of the material, which is cut when both blades come together.

To most persons, scissors and shears refer to the same instrument. But, in the hardware trade, the word *shears* refers to a pair of scissors with blades more than 6 inches (15 centimeters) long. The handles of scissors usually have rings of equal size. Most shears have a larger ring on one handle for the four fingers of the cutting hand. The thumb of the cutting hand fits through the other ring. Scissors and shears range in size from tiny manicuring scissors to giant, power-operated metal shears that cut scrap metal to size for steel-mill furnaces. *Pinking shears,* or *pinking scissors,* have saw-tooth edges. They give cloth a scalloped edge that keeps the thread in the material from raveling. Scissors developed shortly after man learned to make knives. Sharp, sturdy scissors were developed in the late 1200's. WALTER R. WILLIAMS, JR.

SCLERA. See EYE (The Eyeball; color diagram: Parts of the Eye).

SCLEROMETER. See HARDNESS.

SCLEROSIS, MULTIPLE. See MULTIPLE SCLEROSIS.

SCOLIOSIS, *SKOH lee OH sihs,* means a side-to-side curve or bend of the normally straight spine or backbone. Scoliosis may occur in any part of the spine. It may be single (curved like a *C*) or double (curved like an *S*). Scoliosis usually starts in childhood or the teens. It may come from disturbance of growth, paralyzed back muscles, or a short leg. Treatment includes exercises, braces, or surgery. IRVIN STEIN

SCONE, *skoon*, STONE OF, is a coronation stone on which the kings and queens of Great Britain are crowned. It lies beneath a special coronation chair in Westminster Abbey. It is also called the *Stone of Destiny.* King Edward I took the stone from Scotland and brought it to England in 1296. For hundreds of years before that, the kings of Scotland had been crowned on the stone. See also WESTMINSTER ABBEY (picture).

SCOOTER. See MOTORCYCLE.

SCOPES TRIAL. See BRYAN (William Jennings); DARROW, CLARENCE S.; TENNESSEE (The Early 1900's).

SCOPOLAMINE, *skoh PAHL uh meen,* is a drug used as a sedative, to quiet a person and make him drowsy. It is an alkaloid and is sometimes called *hyoscine* (see ALKALOID). Doctors use scopolamine to control acute excitement, delirium tremens, and tetanus. It increases the quieting effect of morphine. These two drugs were formerly popular to produce "twilight sleep" in childbirth. The combination lessened the pain and erased memory of the event. Scopolamine has also been used in remedies for seasickness and airsickness. The effects of scopolamine resemble those produced by atropine, especially when given in doses large enough to be poisonous (see ATROPINE). However, small doses of scopolamine have a sedative action, whereas atropine causes excitement. AUSTIN EDWARD SMITH

SCORIA. See NORTH DAKOTA (Land Regions); ROCK (Extrusive Rocks).

SCORPION, *SKAWR pih un,* is a small animal with a dangerous poisonous sting in its tail. Most people fear the scorpion because of its sting and ugly appearance. The scorpion is not an insect. It belongs to a class of animals called *arachnids.* Spiders, mites, and ticks also belong to this class. Scorpions live in warm countries in most parts of the world. About 20 different kinds live in the United States. One of these lives as far north as Medicine Hat, Alberta, in Canada.

The body of the scorpion has two parts. Its short and thick forward part is called the *cephalothorax.* This part is made up of the head and chest (thorax), which join together. The hind part is the long abdomen. The last six segments of it form a slender tail. Most scorpions are black or yellowish and from $\frac{1}{2}$ to 8 inches (1.3 to 20 centimeters) long.

The scorpion has six pairs of jointed appendages. The first pair are tiny pincers, not visible in the accompanying illustration. The second pair, also a mouth part, have large claws, used to seize and crush prey. The last four pairs are leg parts. There are 6 to 12 eyes—different kinds of scorpions have different numbers. The breathing pores are on the abdomen.

All mother scorpions produce their young alive. The newly born young stay with the mother several days, and cling to her body with their tiny pincers.

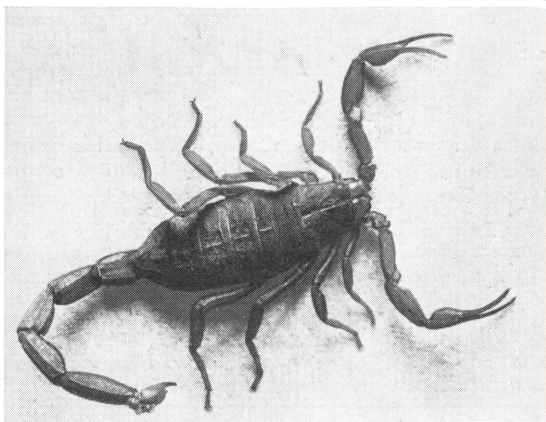
Scorpions eat large insects and spiders, and are most active at night. The scorpion's sting is a curved organ in the end of its tail. Two glands at the base give out a poison that flows from two pores. A scorpion wound is painful, but does not usually cause death. The poison should be sucked or squeezed out of the wound, and the spot should be bathed with ammonia.

Scientific Classification. Scorpions belong to the class *Arachnida,* order *Scorpionida.* The families of scorpions include *Buthidae* and *Chactidae.* EDWARD A. CHAPIN

See also ARACHNID.

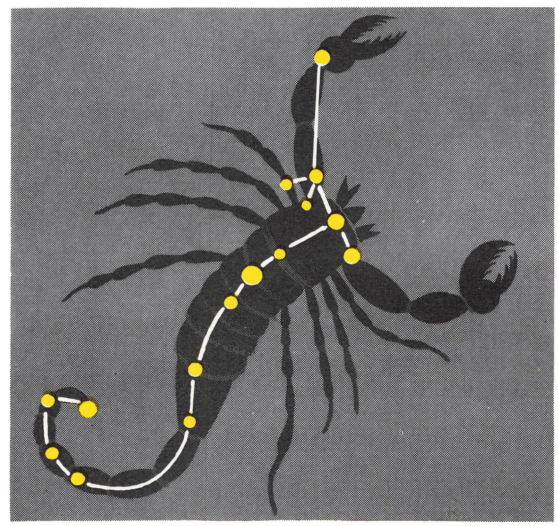
The Scorpion is common in the southwestern part of the United States. It stings its prey and sucks the body juices.

Cornelia Clarke



SCORPION FLY is a small insect with long wings. The male has two slender, pincerlike growths on the end of its body. These growths look like the scorpion's stinger. It is not a true fly because it has four wings instead of two. The scorpion fly is about $\frac{1}{2}$ inch (13 millimeters) or more in length, and its two pairs of wings are netted and as long as its body. The pincers can be used to clasp objects, but they are not a stinging organ. Both adults and larvae feed on dead or dying insects. The adults also eat some vegetable matter. They lay their eggs in cracks in the ground. The larvae, which resemble caterpillars, hatch in about a week and grow rapidly. However, not much is known about the life cycle.

Scientific Classification. The scorpion fly is in the scorpion fly family, *Panorpidae.* A common scorpion fly is genus *Panorpa,* species *P. nebulosa.* DALE W. JENKINS



The Constellation Scorpius, the Scorpion

SCORPIUS, or **THE SCORPION,** is the eighth sign of the zodiac. Its symbol is ♏. The constellation Scorpius appears in the southern part of the sky. It contains the bright star Antares, a giant star which shines with a fiery-red light, and is of the first magnitude of brightness. It has a companion star whose light is greenish. According to Greek mythology, Orion boasted that he would kill every poisonous reptile on earth, and Artemis (Diana) sent the scorpion to kill him. The scorpion was known as a constellation even before the Greeks. It appears in the mythology of the Sumerians. See also ANTARES; ASTRONOMY (Skies of the Seasons); CONSTELLATION; ZODIAC. I. M. LEVITT

John L. Stage, Photo Researchers

The Rugged Highlands cover the northern half of Scotland. Blue lakes and steep valleys make the Highlands one of the most scenic areas in Europe.

SCOTLAND

SCOTLAND is one of the four countries that make up the UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND. The other countries are England, Northern Ireland, and Wales. Scotland is about the same size as South Carolina, but it has about twice as many people as that state. Edinburgh is the capital of Scotland, and Glasgow is the largest city.

Scotland occupies the northern third of the island of Great Britain in the British Isles. Most of Scotland is mountainous. The country's rugged mountains, green valleys, and deep, blue lakes provide some of the most beautiful scenery in Europe.

Most of the Scottish people live in a crowded industrial area in the central part of the country. Many work in shipyards, steel mills, and other large industrial plants, which are the basis of Scotland's economy.

Industrialization has eliminated many of Scotland's old traditions and ways of life. But the Scots have kept many symbols of their long and colorful history—especially of their fierce struggles for independence from England. Parades at Edinburgh Castle, once the home of Scotland's kings, feature troops who wear kilts and march to the music of bagpipes. Scottish soldiers still guard their country's ancient royal crown in the castle, and the royal flag of Scotland still flies over the castle walls.

This article tells about the people, geography, and economy of Scotland. It also traces Scotland's history up to 1746, when the last Scottish revolt against union with England was crushed and Scotland's history became part of that of Great Britain. For a discussion of Great Britain as a whole, of Scotland's relation to the other British countries, and of Britain's history, see the WORLD BOOK article on GREAT BRITAIN.

The contributors of this article are Norman Runnion, Editor of the Brattleboro (*Vt.*) Daily Reformer *and former London correspondent for United Press International; Vernon F. Snow, Professor of History at Syracuse University; and J. Wreford Watson, Professor of Geography at Edinburgh University, Edinburgh, Scotland.*

David Follansbee, Photo Researchers

Edinburgh's Princes Street is one of the world's most beautiful thoroughfares. The Scott Memorial, *left*, honors the Scottish novelist Sir Walter Scott. Edinburgh, Scotland's capital, and most other large Scottish cities are in the central part of the country.

FACTS IN BRIEF

Capital: Edinburgh.

Official Language: English.

Form of Government: Constitutional monarchy; part of the United Kingdom of Great Britain and Northern Ireland (see GREAT BRITAIN [Government]).

Area: 30,414 sq. mi. (78,772 km²). *Greatest Distances*—north-south, 274 mi. (441 km); east-west, 154 mi. (248 km). *Coastline*—about 2,300 mi. (3,700 km).

Elevation: *Highest*—Ben Nevis, 4,406 ft. (1,343 m) above sea level. *Lowest*—sea level along the coast.

Population: *Estimated 1976 Population*—5,255,000; distribution, 71 per cent urban, 29 per cent rural; density, 174 persons per sq. mi. (67 persons per km²). *1971 Census*—5,228,963. *Estimated 1981 Population*—5,281,000.

Chief Products: *Agriculture*—barley, cattle, oats, sheep, wheat. *Fishing*—crabs, herring, lobsters, white fish. *Manufacturing*—automobiles, chemicals, industrial machinery, iron and steel, ships, textiles, whisky.

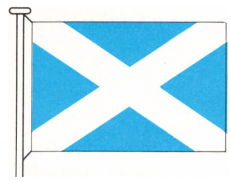
Money: *Basic Unit*—pound. 100 new pence equal one pound. See MONEY (table: Values [Great Britain]). See also POUND STERLING.

SCOTLAND / *Government*

Scotland is part of Great Britain, a constitutional monarchy. Queen Elizabeth II is the head of state, but a Cabinet of government officials called *ministers* actually rules Britain. The *prime minister* is the chief official. *Parliament* makes the laws of Great Britain. It consists of the *House of Commons* and the *House of Lords*. Members of the House of Commons are elected from the four countries of Great Britain. Scotland elects 71 of the House's 630 members. The House of Lords has limited power. Most of its members are noblemen who inherit their seats. For more information on the British government, see GREAT BRITAIN (Government).

In many ways, Scotland has more independence than the three other British countries. Its system of local government and its judicial and educational systems differ from those of England, Wales, and Northern Ireland.

Scotland's chief administrative official is the *secretary*

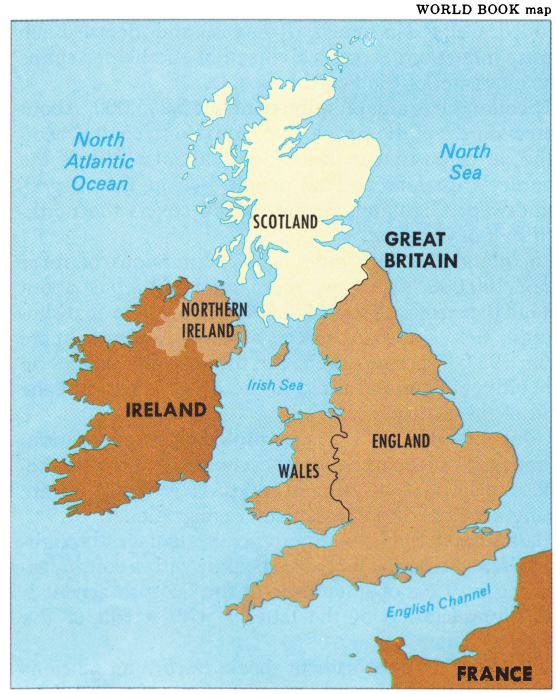


Scotland's Flag is called *St. Andrew's Cross*. The flag has never been officially adopted, but the Scottish people have flown it for hundreds of years.

The Royal British Arms are used in Scotland. The lion in two corners of the shield was Scotland's arms before the country became part of Britain.

Scotland covers about a third of the island of Great Britain. The country is about as large as the state of South Carolina.

WORLD BOOK map



of state for Scotland. He is appointed by the British prime minister and is a member of the Cabinet. The secretary's office, called the *Scottish Office,* is in London. But the day-to-day administration of Scotland is conducted in Edinburgh by various departments of the Scottish Office.

The Scottish Office has four main departments. The *Department of Agriculture and Fisheries* deals with Scotland's agricultural and fishing industries. The *Scottish Development Department* is concerned with such fields as housing, public utilities, and transportation. The *Scottish Education Department* supervises public education. The *Scottish Home and Health Department* is responsible for criminal justice, police and fire protection, prisons, and public health. Each department is run by a secretary who is responsible to the secretary of state for Scotland.

In addition to the four main departments, several smaller administrative departments are under the secretary of state. They include the *Social Work Services Group,* the *Scottish Information Office,* and the *Scottish Record Office.*

For purposes of local government, Scotland is divided into 12 regions. These regions are subdivided into districts. Both the regions and the districts have elected councils.

The Scottish judicial system is based on Roman *civil law* instead of English *common law.* Under civil law, court decisions are based on legislation. Under common law, they are based on custom and previous court decisions. See CIVIL LAW; COMMON LAW; GREAT BRITAIN (Law Courts).

A number of Scots belong to the Scottish Nationalist Party, which seeks complete independence for Scotland from Great Britain. The Act of Union, passed by the parliaments of Scotland and England in 1707, provided that both countries be united under one government forever. But the Nationalists argue that neither Parliament nor the secretary of state for Scotland can govern their country effectively from London.

SCOTLAND / *People*

The Scottish people have long been famous for their close-knit *clans* (groups of related families), colorful plaid kilts, and skill as fierce warriors. But the clans have lost much of their importance, kilts are worn mainly for ceremonial occasions, and no war has been fought in Scotland for more than 200 years. Today, most Scotsmen are wage earners who live in or near large industrial cities.

Ancestry and Population. Most of the Scottish people are descended from invaders who began to settle in Scotland about 2,300 years ago. These invaders included Celts, Norsemen, Romans, and Scots. Each group influenced Scottish civilization and helped shape the character of the Scottish people.

Scotland has a population of about 5,255,000. About three-fourths of the people live crowded in central Scotland, a region that makes up only about a fifth of the country's total area. Few people live in the rugged, windswept Highlands region, which covers the northern half of Scotland.

Scotland has four cities with populations of more than 100,000. Glasgow, the largest city, has about 984,000 persons. About 472,000 persons live in Edinburgh, the capital. Aberdeen and Dundee have more than 195,000 persons each. See the separate articles on the cities of Scotland listed in the *Related Articles* at the end of this article.

One of Scotland's major problems is emigration. Thousands of Scots leave the country each year because of limited job opportunities. New industries are being developed to check further emigration.

Language. English is the official language throughout Great Britain. The Scots speak it with a soft, musical accent. One characteristic of the Scottish accent is the pronunciation of the letter *r* with a trill of the tongue.

About 80,000 Scotsmen speak *Gaelic,* an ancient Celtic language. Most of these people live in the High-

Slim Aarons, Photo Researchers

Scottish Schoolboys generally wear coats and ties to school. All Scottish children between the ages of 5 and 16 must attend school. Most of them go to schools supported by public funds.

J. Pugh, DPI

Bruce Davidson, Magnum

Picturesque Fishing Villages are popular seaside resorts in Scotland. The old village of Crail, *left,* is a favorite resort on the east coast. Many of the village women, *right,* help clean the fishermen's catches. Fishing is an important industry in Scotland.

lands or on Scotland's hundreds of offshore islands. See GAELIC LANGUAGE.

Way of Life. Most Scottish people live in industrial cities and towns. Their way of life is similar to that of people in industrial areas of England, Canada, and the United States. Most Scots live in small houses or apartments, about half of which are owned by local governments.

Many Scottish families spend the evening watching television. Scotland has two television networks—the British Broadcasting Corporation (BBC) and the Independent Television Authority (ITA). The British government regulates both networks, and television owners must pay yearly license fees. The fees help finance the BBC, which does not have commercials. The ITA broadcasts commercials every half hour, but advertisers do not sponsor programs.

Most Scottish farmers rent their land. In the Highlands and along the English border are vast estates belonging to landowners called *lairds*. Most of these estates are divided into large tenant farms. In the western Highlands, farmers called *crofters* rent small plots of land. Many crofters must also hold other jobs to make a living.

Scotland has cool summers and cold winters. As a result, many people wear warm tweed suits and coats and thick woolen sweaters the year around. Much of their clothing comes from Scotland's famous woolen mills. A few Highlanders wear kilts every day.

Traditions. Most Scottish traditions began with the clans. The clans are made up of families who have a common ancestor and the same name, such as MacDonald, MacGregor, Douglas, or Scott. The clans began in Scotland hundreds of years ago. They were organized under chieftains and became known for their feuds. Today, the clans have little importance in the life of the members. Each clan is still headed by a chieftain, but he is mainly symbolic and has no real authority over the members. See CLAN.

The most famous feature of the clans is their plaid kilts. Each clan has its own plaid design called a *tartan*. The tartan is used for shirts, ties, and other clothing, as well as for kilts. See TARTAN.

Bagpipe music, with its high-pitched sounds, is another famous Highland tradition. The bagpipe and kilt have become well-known symbols of Scotland. See BAGPIPE.

Food and Drink. Most Scottish cooking is simple. The people's favorite dishes include herring, mutton stew, roast beef, and roast lamb. They also enjoy high-quality steaks from their country's famous Aberdeen-Angus cattle.

Other popular Scottish foods include haggis, kippers, oatmeal, and salmon. *Haggis* is a famous national dish made from the heart, liver, and lungs of a sheep or calf. These ingredients are chopped with *suet* (animal fat), onions, oatmeal, and seasonings, and then boiled in a bag made from a sheep's stomach (see HAGGIS). *Kippers* are smoked herring and are a favorite breakfast dish. Oatmeal is used in many Scottish dishes, including porridge and *oatcakes* (crackers), both of which are popular for breakfast. Salmon is served smoked, grilled, or poached. Salmon taken from Scottish waters is considered one of the world's tastiest foods.

Scotland's favorite alcoholic drink is Scotch whisky, or Scotch. Most Scotsmen drink it without water or

soda. The Scots have been making whisky since the 1400's. They export more than 40 million gallons (150 million liters) of Scotch a year, about half of which goes to the United States.

Tea is popular throughout Great Britain. Some Scots have *afternoon tea* at about 4 P.M. It consists of tea, sandwiches, and cakes. At about 8 P.M., they eat dinner. Other Scots have a meal called *high tea* at about 6 P.M. It serves as supper and consists of tea; a light main course, such as sausages or *fish and chips* (fried fish and French fried potatoes); and cakes.

Recreation. Most Scots enjoy sports and outdoor activities. Scotland's huge open lands make excellent recreational areas.

The Scots invented golf in the 1100's, and it is still one of their favorite games. Scotland's many golf courses include the world-famous Royal and Ancient Golf Club in St. Andrews. See GOLF (History).

Scotland's most popular organized sport is *association football*, or soccer. Thirty-eight professional teams play in the Scottish Football League. Teams made up of outstanding players from the league play teams from England, Wales, and the Republic of Ireland. Rugby, which is similar to football, is also popular. See SOCCER; RUGBY FOOTBALL.

The Highland Games, which resemble track meets, are held throughout the Highlands during the spring, summer, and early fall. Field events include tossing the *caber*, a long wooden pole that weighs about 180 pounds (82 kilograms). Athletes compete to see who can heave it the farthest. Other events of the Highland Games include foot races and dancing and bagpipe competitions. The British royal family traditionally attends the games held in Braemar.

People from throughout the world come to fish for trout and salmon in the clear mountain streams of the Highlands. Hiking, mountain climbing, and shooting are also popular in the Highlands. The area around 4,406-foot (1,343-meter) Ben Nevis, the highest peak in the British Isles, is one of the best mountain-climbing regions in Europe.

Popular winter sports in Scotland include skiing and curling. *Curling* is a game in which the players slide heavy stones across a sheet of ice toward a target (see CURLING).

Education. Scotland's system of education is separate from that of England and Wales and from that of Northern Ireland. The Scottish Education Department and local education authorities supervise the school system in Scotland. The local authorities are similar to boards of education in the United States.

All Scottish children between the ages of 5 and 16 must attend school. Nearly all the students go to schools supported by public funds. Scotland has few private schools.

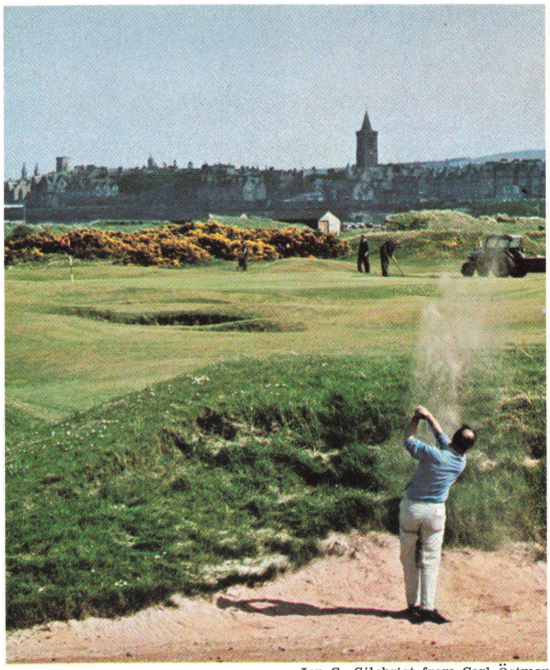
For many years, Scotland has had separate schools for vocational and academic education. Many local authorities are replacing the specialized schools with

David Hurn, Magnum

Bagpipes and Kilts have been well-known symbols of Scotland for hundreds of years. Bagpipe bands in traditional Highland costumes are popular features at many Scottish events.

Don Evins from Tom Stack

Sheep Shearing is an important activity in many Highland communities. These skilled shearers are using hand clippers to remove the wool. The Highlands are well suited for raising sheep.



Ian G. Gilchrist from Carl Östman

The Royal and Ancient Golf Club, one of the most famous golf courses in the world, lies on the outskirts of St. Andrews. Golf was invented in Scotland in the 1100's.

comprehensive schools. These schools provide both types of education, and students take courses geared to their abilities.

Scotland has eight universities—Aberdeen, Dundee, Edinburgh, Glasgow, Heriot-Watt, St. Andrews, Stirling, and Strathclyde. Aberdeen, Glasgow, and St. Andrews were founded in the 1400's. Edinburgh and Glasgow are the largest universities. See EDINBURGH, UNIVERSITY OF; GLASGOW, UNIVERSITY OF.

Religion. The Church of Scotland, or Presbyterian Church, is the official church of Scotland. But the people may worship as they choose, and many are Baptists, Congregationalists, Episcopalians, Free Presbyterians, Methodists, or Roman Catholics.

The Church of Scotland has about 1,178,000 members. The members elect about 1,400 ministers and *elders* (officers) of the church to the General Assembly of the Church of Scotland, which meets once a year. The assembly is often called the *Voice of Scotland* because it discusses national and world affairs as well as church matters. The British monarch often attends the assembly meeting.

The Arts. Scotland has produced many famous artists, especially in the field of literature. The earliest Scottish writers were *bards* (poets) who wrote in the ancient Gaelic language. Between the 1300's and 1700's, famous Scottish poets included John Barbour, Gawin Douglas, William Dunbar, and Allan Ramsay. Robert Burns, who wrote in the late 1700's, became the national poet of Scotland. He wrote many works in Scottish dialect. Today, many Scottish poets, including Hugh McDiarmid, Tom Scott, and Douglas Young, use dialect. See GAELIC LITERATURE.

Most Scottish prose is written in English. Famous Scottish authors of the 1700's include James Boswell, who wrote a fascinating biography of the English writer Samuel Johnson, and John Arbuthnot, who wrote many great essays. During the 1800's, Thomas Carlyle produced brilliant histories and biographies, and John Lockhart became known for his works of literary criticism. Scotland's best-known novelists, Sir Walter Scott and Robert Louis Stevenson, also wrote during the 1800's. Scott's most famous work is *Ivanhoe*. Stevenson's novels include *Treasure Island* and *Kidnapped*. Sir James Barrie, who wrote *Peter Pan* and other popular plays, lived during the late 1800's and early 1900's.

Scotland's first important painters were the portrait painters Allan Ramsay (the son of the poet) and Sir Henry Raeburn, who lived in the 1700's and early 1800's. Other famous painters since then include Sir James Guthrie, W. Y. Macgregor, William MacTaggart, Sir William Q. Orchardson, John Pettie, and Sir David Wilkie.

Scottish music has traditionally centered on the bagpipe. The Scots divide bagpipe music into big music and little music. *Big music* includes warlike or sad songs called *pibrochs*. *Little music* includes marches and music for dancing. The Scottish reel, the Highland fling, the sword dance, and other traditional dances are performed to little music. The Edinburgh International Festival of the Arts, held in Edinburgh each August, features musical and dramatic productions.

Regions of Scotland

Name	Population	Map Key
Borders	99,000	G 7
Central	263,000	F 5
Dumfries and Galloway	144,000	G 6
Fife	328,000	F 7
Grampian	437,000	D 7
Highland	175,000	D 5
Lothian	742,000	F 6
Orkney	17,000	A 6
Shetland**	18,000	
Strathclyde	2,578,000	F 5
Tayside	397,000	E 6
Western Isles	31,000	C 4

Cities and Towns

Aberdeen .208,000..D 7
Airdrie* ...38,281..F 6
Alloa* .....13,907..F 6
Alva* .....4,386..F 6
Annan .....6,152..H 6
Arbroath ...22,921..E 7
Ardrossan* .10,867..F 5
Armadale* ..7,063..F 6
Ayr .....47,914..G 5
Bannockburn 3,887†..F 6
Barrhead* ..18,537..F 5
Bathgate* ..14,088..F 6
Bearsden* ..25,029..F 5
Bishopbriggs* ..21,308..F 6
Blairgowrie [and Rattray] ..5,661..E 6
Bo'ness* ...12,978..F 6
Bonnyrigg and Lasswade* 7,220..F 7
Brechin ....6,685..E 7
Bridge of Allan* ....4,498..F 6
Buckhaven and Methil* ..18,209..F 7
Buckie .....8,062..C 7
Burntisland* 5,658..F 6
Campbeltown 6,084..G 4
Carnoustie* .6,568..E 7
Clydebank* .47,924..F 6
Coatbridge .51,493..F 6
Cowdenbeath* ...10,300..F 6
Crieff .....5,658..E 6
Cumbernauld* ...34,100..F 6
Cumnock [and Holmhead] 6,076..G 6
Cupar .....6,662..E 7
Dalkeith* ...9,717..F 7
Denny and Dunipace* ....10,123..F 6
Dumbarton .25,348..F 5
Dumfries ..29,041..G 6
Dunbar .....4,553..F 7
Dunblane* ..4,921..F 6
Dundee ...198,000..E 7
Dunfermline 51,798..F 6
Dunoon* ....8,562..F 5
East Kilbride .66,300..F 6
Edinburgh 472,000..F 7
Elgin .....16,769..C 6
Falkirk ....37,208..F 6
Forfar .....10,897..E 7
Forres .....5,094..C 6
Fort William .....4,313..E 5
Fraserburgh 10,763..C 7
Galashiels ..12,569..G 7
Galston* ....4,250..G 5
Girvan .....7,573..G 5
Glasgow ...984,000
*1,698,231..F 6
Glenrothes .28,900..F 6
Gourock* ...11,188..F 5
Grangemouth ...24,469..F 6
Greenock ...68,472..F 5
Haddington* 6,672..F 7
Hamilton ..46,002..F 6
Hawick ....16,238..G 7
Helensburgh* ..12,182..F 5
Inverkeithing* .....5,946..F 6
Inverness ..34,979..D 6
Inverurie ....5,483..D 7
Irvine .....44,100..G 5
Johnstone* ..23,130..F 5
Keith .....4,230..D 7
Kelso .....4,922..G 7
Kilmarnock 49,688..G 5
Kilsyth* ...10,222..F 6
Kilwinning* 8,340..F 5
Kirkcaldy ..49,871..F 6
Kirkintilloch* ....26,163..F 5
Kirkwall ....4,710..A 7
Lanark .....8,648..F 6
Largs* .....9,430..F 5
Lerwick** 6,282
Leven* .....9,581..F 7
Linlithgow* .5,963..F 6
Livingston* 16,100..F 6
Loanhead* ...5,956..F 7
Lochgelly* ..7,906..F 6
Lossiemouth [and Brandergburgh] ....5,824..C 6
Maybole ....4,575..G 5
Milngavie* ..10,765..F 5
Monifieth ...6,832..E 7
Montrose ...10,096..E 7
Motherwell [and Wishaw] .73,562..F 6
Musselburgh 16,854..F 7
Nairn .....5,541..D 6
North Berwick ...4,242..F 7
Oban .....6,418..E 5
Paisley ....95,314..F 5
Peebles .....5,981..F 6
Penicuik ...10,209..F 6
Perth .....42,583..E 6
Peterhead ..14,596..D 8
Port Glasgow* 22,254..F 5
Portree .....1,356†..D 4
Prestwick ..13,430..G 5
Queensferry* 5,425..F 6
Renfrew* ...18,717..F 5
Rothesay ...6,282..F 5
Rutherglen* 24,396..F 6
St. Andrews 12,522..E 7
Saltcoats ..14,804..G 5
Selkirk .....5,636..G 7
Stevenston* 11,750..F 5
Stewarton* ..4,847..F 5
Stirling ....30,047..F 6
Stonehaven ..4,818..D 7
Stornoway ..5,272..C 4
Stranraer ..10,102..H 5
Thurso .....9,108..B 6
Tranent* ....7,082..F 7
Troon* .....11,600..G 5
Whitburn* ..10,997..F 6
Wick .....7,755..B 6

Sources: Official estimates (1971 for regions and four largest cities and 1972 for other places).
*Does not appear on map; key shows general location.
**Shetland Region, or Shetland Islands, appears on the map of Great Britain.
*Population of metropolitan area, including suburbs.
†1961 census figure.

Scotland occupies the northern third of the island of Great Britain. The River Tweed and the Cheviot Hills form Scotland's southern border with England. The North Channel separates southwestern Scotland from Northern Ireland. The northwest coast faces the Atlantic Ocean. The east coast faces the North Sea, which separates Scotland from the mainland of Europe.

Land Regions. Scotland has three main land regions. They are, from north to south, the Highlands, the Central Lowlands, and the Southern Uplands.

The Highlands are a rugged, barren region that covers the northern half of Scotland. Two major mountain ranges, the Northwest Highlands and the Grampian Mountains, rise in this region. The ranges have parallel ridges that run through the Highlands from northeast to southwest. A deep valley called *Glen More* or the *Great Glen* separates the two mountain ranges. The highest peak in the British Isles, 4,406-foot (1,343-meter) Ben Nevis, rises south of Glen More. The Highlands have two kinds of valleys—steep, narrow *glens* and broad, rolling *straths*. Much of the land in the Highlands is a treeless wasteland called a *moor* or *heath*. The most rugged land lies along the west coast. Most Highlanders live on the narrow coastal plains.

The Central Lowlands are crossed by the valleys of the Clyde, Forth, and Tay rivers. This region has Scotland's best farmland and most of its mineral resources. Wide, fertile fields and low hills with patches of trees cover the entire region. Most of the Scottish people live in the lowlands.

The Southern Uplands consist of rolling moors, broken in places by rocky cliffs. The tops of the hills are largely barren, but rich pastureland covers most of the lower slopes. Many sheep and cattle are raised in the region. In the south, the uplands rise to the Cheviot Hills.

Rivers and Lakes. The River Clyde is Scotland's most important river. Ships from the Atlantic Ocean can sail up the Clyde to Glasgow. The Clyde was narrow and shallow until the 1700's, when engineers widened and deepened the river to make it navigable. Scotland's longest rivers flow eastward into the North Sea. The Tay, 120 miles (193 kilometers) long, is the largest river. It carries more water than any other river in Great Britain. See Clyde, River; Tay River.

Skyport from Publix

Ben Nevis, *center,* **the highest peak in the British Isles, rises 4,406 feet (1,343 meters) in the Scottish Highlands. The area around Ben Nevis is one of Europe's best mountain-climbing areas.**

PHYSICAL MAP OF SCOTLAND

This map shows the three major regions of Scotland—the Highlands, the Central Lowlands, and the Southern Uplands. A deep valley called Glen More divides the Highlands into two mountain ranges—the Northwest Highlands and the Grampian Mountains.

Many of Scotland's rivers flow into wide bays called *firths*. The firths of Clyde and Lorne lie on the west coast. The firths of Forth and Tay and Moray Firth are on the east coast. All ships bound for Glasgow must pass through the Firth of Clyde. A suspension bridge, one of the longest in the world, spans the Firth of Forth at Queensferry. It is 8,244 feet (2,513 meters) long. See Firth of Clyde; Firth of Forth.

Most of Scotland's lakes, which are called *lochs*, lie in deep Highland valleys. Loch Lomond is the country's largest lake. It is 23 miles (37 kilometers) long and 5 miles (8 kilometers) wide at its widest point. A series of lakes extends through Glen More. These lakes are connected by canals and form the Caledonian Canal, which cuts across Scotland from Moray Firth to the Firth of Lorne. One of the canal's lakes, Loch Ness, is famous for its "monster." Some people claim to have seen a creature 30 feet (9 meters) long in the lake. Along the west coast of Scotland, the Atlantic Ocean extends inland in many narrow bays called *sea lochs*. See Loch Lomond; Loch Ness.

Islands. Scotland has hundreds of offshore islands. A large group of islands called the Hebrides lies off the west coast. The Orkney and Shetland groups of islands lie north of Scotland and form the boundary between the North Sea and the Atlantic Ocean. See Hebrides; Orkney Islands; Shetland Islands.

The economy of Scotland depends mainly on manufacturing and trade. Manufacturing has been important in Scotland since the Industrial Revolution began in Britain during the 1700's. The country cannot produce enough food for its people, and it has limited natural resources. As a result, Scotland must import much food and most of the raw materials it needs for industry.

Natural Resources. Scotland has few natural resources, except for large fields of natural gas off the North Sea coast, small deposits of coal in the Central Lowlands, and plentiful water supplies in the Highlands. In the Highlands, many rivers have been dammed to produce electric power. Scotland has the largest hydroelectric plants in Great Britain. To enlarge the country's small forests, the government is carrying out a large reforestation program in the Highlands and Southern Uplands. One of Scotland's most valuable resources is its excellent fishing grounds off the east and north coasts.

Manufacturing. About 35 per cent of Scotland's workers are employed in manufacturing. The country's chief manufactured products include aluminum, automobiles, chemicals, industrial machinery, iron and steel, ships, textiles, and whisky.

Most of Scotland's factories are in the Central Lowlands. Glasgow, the center of the metal-making industry, produces large quantities of iron and steel. A region called Clydeside, along the banks of the River Clyde, is one of the world's greatest shipbuilding centers. Well-known ocean liners built there include the *Queen Mary*, *Queen Elizabeth*, and *Queen Elizabeth II*. Dundee is famous for its *jute*, used to make burlap, gunny sacks, and similar items, and for its linen. Edinburgh is Scotland's publishing center. The city is also known for its breweries and distilleries.

Transportation and Trade. More than 28,000 miles (45,100 kilometers) of highways crisscross Scotland. A major highway system links Glasgow and Edinburgh and connects both cities with London.

Scotland has about 6,500 miles (10,500 kilometers) of railroad track. The British government owns the railways. Fast trains run between the major cities of Scotland and England. Scotland's two major airports are at Prestwick and at Abbotsinch, near Glasgow. Prestwick handles many transatlantic flights.

Scotland's chief export is Scotch whisky. Other important exports include automobiles and tractors, electronic equipment, marmalade, ships, and textiles. Scotland's main imports include food, raw materials, and fuels.

Ian G. Gilchrist from Carl Östman

Shipyards in Clydeside, a region along the River Clyde, make up one of the world's greatest shipbuilding centers. Many famous ocean liners and warships were built in this region.

Agriculture and Fishing. Although about three-fourths of Scotland's land area is used for agriculture, the country cannot produce enough food for its people. Much food must be imported.

The Central Lowlands have some of the best farmland in Great Britain. Oats, which are used to feed cattle, are grown on about half the land in this region. Most farmers rotate oats with potatoes, ryegrass, and turnips. Other important crops include barley, fruits, and wheat.

The mountainous plateaus of the Highlands and the Southern Uplands are used mainly for grazing sheep. Most of the sheep are Scottish Blackface sheep, which can stand the country's cold winters better than other breeds can.

Scottish farmers developed many famous breeds of cattle, including Ayrshire, Aberdeen-Angus, Galloway, and Highland. They also developed the strong Clydesdale workhorse, the Shetland pony, and a famous sheep dog, the collie.

Fishermen bring in large catches of crabs, herring, and lobsters from Scottish waters. They also catch *white fish*, such as cod, haddock, and sole. Scotland's leading fishing port is Aberdeen. Fleets from Aberdeen range from Greenland to northern Russia.

Sid Latham, Photo Researchers

World-Famous Scotch Whisky is carefully blended from various alcoholic spirits. Whisky is Scotland's most important export, and distilleries are found throughout the country.

SCOTLAND / *History*

Historians believe that the first people to live in Scotland came from the European mainland about 6,000 years ago. They used flint tools, built boats, and made pottery. About 1800 B.C., people called the *Beaker folk* settled in northern Scotland. Their name comes from small clay containers called *beakers*, which they buried with their dead. These people also made tools and other items of bronze. Celtic tribes invaded Scotland about 300 B.C. The Celts came from western Europe and introduced the use of iron in Scotland. See CELT.

The Roman Invasion. A Roman army commanded by Gnaeus Julius Agricola, the Roman governor of England, invaded Scotland in A.D. 80. The Romans called Scotland *Caledonia*. The invaders called the people *Picts* (painted people) because they painted their bodies (see PICT).

Agricola defeated the Picts and returned to Rome. The Romans who remained in Scotland had trouble controlling the Picts. They built forts and walls to defend themselves. One of the most famous walls, Hadrian's Wall, was built across northern England in the A.D. 120's. It was named after the Roman emperor Hadrian. The Romans also built roads and towns in Scotland. They left the country in the early 400's.

Beginning of the Scottish Kingdom. About A.D. 500, a Celtic tribe called the *Scots* came from northern Ireland and settled on Scotland's west coast. Saint Columba, an Irish monk, followed the Scots in 563. He founded a monastery and, with the help of the Scots, began to convert the Picts to Christianity.

In 844, Kenneth MacAlpin, king of the Scots, became king of the Picts as well. He established Alba, the first united kingdom in Scotland.

Many violent struggles for the Scottish throne began in the late 900's. In 997, Kenneth III became king by killing Constantine III. In 1005, Malcolm II killed Kenneth III. Duncan I, who followed Malcolm II, was murdered by Macbeth, one of his generals, in 1040. In 1057, Duncan's son, Malcolm III, killed Macbeth.

Malcolm III married an English princess and was greatly influenced by English customs. After the Normans conquered England in 1066, Malcolm permitted English refugees to settle in Scotland. He gave land to some of them and introduced feudalism into Scotland. Under feudalism, lords gave land to people in exchange for military and other services (see FEUDALISM).

Struggles with England. Malcolm died in 1093. The Scottish kings who followed him fought England for about 150 years. The English wanted to control the entire island of Great Britain, including Scotland. But the Scots were determined to remain independent. They frequently sided with France, England's enemy, against the English.

During the reign of Alexander III, from 1249 to 1286, Scotland advanced in many ways. Agriculture and trade flourished, and many roads and bridges were built. A border was established between Scotland and England, and the two countries remained at peace.

Fight for Independence. In 1286, Alexander's 3-year-old granddaughter, Margaret, followed him as ruler of Scotland. But she died four years later. A number of Scottish barons then fought for the throne. In 1292, Edward I of England recognized one baron, John de Baliol, as king. In return, Baliol was supposed to recognize Edward as his superior. But he refused to do so and formed a military alliance with France instead.

Detail of a mural (1900) by William Hole; Scottish National Portrait Gallery, Edinburgh, Scotland

The Legendary Robert Bruce, *center,* **defeated Edward II of England in the famous Battle of Bannockburn in 1314. As a result of the victory, Scotland eventually gained its independence from England, and Bruce was named King Robert I of Scotland.**

Edward invaded Scotland in 1296 and won the important Battle of Dunbar. He then seized the Stone of Scone, the Scottish symbol of royal authority, and declared himself king of Scotland. The Scots soon renewed the revolt. Under William Wallace, Scotland's first popular hero, they won several victories. But in 1305, the English captured and executed Wallace.

Robert Bruce led the revolt after Wallace's death. He defeated Edward II in the famous Battle of Bannockburn in 1314 (see BANNOCKBURN, BATTLE OF). But Edward still refused to recognize Scotland's independence. The Scots officially declared their independence in 1320. In 1328, Edward III finally recognized Bruce as King Robert I of Scotland.

The House of Stuart. David II, Bruce's son, died in 1371 without an heir. Several families claimed the Scottish throne. But the *House* (family) of Stuart won the struggle, and Robert II became king. The Stuarts kept close ties with France and fought continually with England. In 1503, James IV tried to make peace with England by marrying Margaret Tudor, an English princess. But he soon returned to a policy of close cooperation with France. The queen of France, Anne of Brittany, urged James to declare war against Henry VIII of England. James invaded England in 1513 and was killed in the Battle of Flodden Field. Scottish troops were again defeated by the English in 1542. James V, son of James IV, died that same year. His daughter, Mary, Queen of Scots, then became ruler of Scotland.

The Scottish Reformation. Before the 1560's, the Roman Catholic Church was the official church of Scotland. Many Scottish leaders resented the Catholic Church's power and France's strong influence on the church. John Knox, a Scottish minister, led the Scots in establishing the Presbyterian Church as the national church in the 1560's. This action occurred about the same time that the Reformation, the religious movement that led to Protestantism, spread across northern Europe. See REFORMATION.

In 1567, Mary, a Catholic, was forced to give up the Scottish throne in favor of her infant son, James VI. Mary fled to England but was captured there and imprisoned. Elizabeth I of England had Mary executed in 1587. James VI was raised as a Protestant, and the Presbyterian Church became firmly established as Scotland's national church during his reign.

War with the King. When Elizabeth I of England died in 1603, James VI of Scotland inherited the English throne. He moved to London, took the title of King James I of England, and ruled Scotland and England as separate kingdoms. Thus, the two countries became joined in a *personal union* under one king. During his reign, James encouraged the establishment of Scottish colonies in Ireland and America. He also began to reorganize the Presbyterian Church.

James's son, Charles I, continued the same policies of church reform. But in 1638, a group of Scots signed the *National Covenant,* an agreement in which they pledged to keep the Presbyterian Church as it was. In 1642, English Puritans, led by Oliver Cromwell, turned against Charles, and civil war broke out in England. The Scottish Covenanters supported Cromwell and the Puritans. The Puritans won the war, and Charles fled to Scotland. But the Covenanters captured the king and turned him over to the Puritans, who beheaded him in 1649.

After Charles I's death, the Scots persuaded his son, who later became Charles II, to agree to the National Covenant. They then defied Cromwell and declared Charles II king. But Cromwell defeated Charles's forces in the Battle of Dunbar in 1650. In 1654, Cromwell forced the Scots to unite with England.

Charles II finally became king in 1660. He dissolved the union between Scotland and England and, like his

IMPORTANT DATES IN SCOTLAND

A.D. 80 A Roman army invaded Scotland and conquered the Picts.

844 Kenneth MacAlpin established Alba, the first united kingdom in Scotland.

1314 Robert Bruce defeated an English army in the Battle of Bannockburn.

1320 Scotland declared its independence from England.

1328 The English recognized Scottish independence, and Robert Bruce became king of Scotland.

1560's The Presbyterian Church became the national church of Scotland.

1603 Scotland and England became joined in a *personal union* under one king.

1707 The Act of Union joined Scotland with England and Wales, forming the United Kingdom of Great Britain.

1715 The English put down the first Jacobite rebellion.

1746 The English won the Battle of Culloden Moor, ending the second Jacobite rebellion.

(For later dates, see GREAT BRITAIN [History]).

father and grandfather, ruled the countries separately.

Union with England. After Charles's death, English and Scottish leaders realized that their countries must be united to preserve peace. In 1707, the Scottish and English parliaments passed the Act of Union. The act joined Scotland with England and Wales under one kingdom—the United Kingdom of Great Britain. Scottish laws and the Presbyterian Church remained unchanged. But the Scots dissolved their Parliament and sent representatives to the British Parliament.

After the union, many Highland Scots remained loyal to the House of Stuart. They were called *Jacobites*, after *Jacobus*, the Latin name of their leader, James Edward Stuart. James was called the *Old Pretender* because he *pretended to* (claimed) the throne. In 1715, he helped lead the Jacobites in a rebellion against English rule. The rebellion was crushed, and James fled to France.

The Highlanders revolted again in 1745. This time, they were led by James's son Charles, the *Young Pretender*. The Highlanders called him *Bonnie Prince Charlie*. Charles's clansmen easily defeated the English troops in Scotland and then marched into England. In 1746, the English forced Charles into battle on Culloden Moor and defeated him. Charles fled back to the Highlands and escaped to France. As a result of the revolt, the English executed many clan chiefs. They also disarmed the Highlanders and outlawed kilts and bagpipes. These restrictions were removed in 1782, after the threat of more Jacobite rebellions had passed.

After the second Jacobite rebellion, the history of Scotland became part of the history of Great Britain. For the story of Great Britain, see GREAT BRITAIN (History).

NORMAN RUNNION, VERNON F. SNOW, and J. WREFORD WATSON

SCOTLAND / *Study Aids*

Related Articles in WORLD BOOK include:

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Bruce, Robert
David (kings of Scotland)
Duncan I
James (I, kings of England)
Macbeth
Mary, Queen of Scots

POLITICAL AND MILITARY LEADERS

Balfour, Arthur J.
Bothwell, Earl of
Campbell-Bannerman, Sir Henry
Haig, Earl
Henderson, Arthur
Tedder, Arthur W.
Wallace, Sir William

OTHER BIOGRAPHIES

Adam (brothers)
Baird, John L.
Black, Joseph
Broom, Robert
Brown, Robert
Burns, Robert
Chalmers, Thomas
Dunlop, John B.
Fleming, Sir Alexander
Frazer, Sir James G.
Geikie, Sir Archibald
Hume, David
Kelvin, Lord
Knox, John
Lauder, Sir Harry
Lipton, Sir Thomas
Macleod, John J. R.
Manson, Sir Patrick
Maxwell, James Clerk
McAdam, James Loudon
Mill (James)
Napier, John
Nasmyth, James
Primrose, William
Raeburn, Sir Henry
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Scott, Sir Walter
Selkirk, Alexander
Selkirk, Earl of
Simpson, Sir James Y.
Smith, Adam
Stevenson, Robert
Stevenson, Robert Louis
Telford, Thomas
Todd, Lord
Watson-Watt, Sir Robert A.
Watt, James

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Ayr
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Bannockburn, Battle of
Caledonia
Celt
Covenanters
Gael
Pict
Stuart, House of

ISLANDS

Hebrides
Orkney Islands
Shetland Islands

PHYSICAL FEATURES

Ben Lomond
Ben Nevis
Clyde, River
Doon, River
Firth of Clyde
Firth of Forth
Galloway
Inchcape Rock
Loch Katrine
Loch Lomond
Loch Ness
Minch, The
Tay, River
Trossachs
Tweed, River

OTHER RELATED ARTICLES

Abbotsford
Bagpipe
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Curling
Dancing (picture: The Sword Dance)
Doll (color picture)
Edinburgh, University of
Glasgow, University of
Golf (History)
Haggis
Holyrood
Tartan
Tweed

Outline

I. Government
II. People
- A. Ancestry and Population
- B. Language
- C. Way of Life
- D. Traditions
- E. Food and Drink
- F. Recreation
- G. Education
- H. Religion
- I. The Arts

III. The Land
- A. Land Regions
- B. Rivers and Lakes
- C. Islands

IV. Economy
- A. Natural Resources
- B. Manufacturing
- C. Transportation and Trade
- D. Agriculture and Fishing

V. History

Questions

What are two well-known symbols of Scotland?
What are some popular foods in Scotland?
Who is Scotland's chief administrative official?
What was the Act of Union?
What are the Highland Games?
Who were the Jacobites?
What is a *laird?* A *crofter?*
What is Scotland's most important export?
Why is the General Assembly of the Church of Scotland called the *Voice of Scotland?*
What are some famous breeds of animals developed by the Scots?

SCOTLAND YARD

SCOTLAND YARD is the headquarters of the London Metropolitan Police. The name *Scotland Yard* is often used to mean a special department of the force called the *Criminal Investigation Department*, or C.I.D. The C.I.D. is one of the most famous police organizations in the world. Detective story writers have made Scotland Yard men the heroes of many thrilling tales.

Scotland Yard gets its name from the building that housed the London police until 1890. This was an ancient structure where visiting Scottish kings and ambassadors stayed between the 900's and the 1100's. In 1890, the Metropolitan Police moved into offices on the Thames Embankment. These offices were named New Scotland Yard. In 1967, New Scotland Yard moved to the Westminster section of London. JOHN J. FLOHERTY

SCOTT, BARBARA ANN (1928-), became the first North American girl to win the Olympic, European, and world figure-skating championships. She won the Canadian championship three times, and the North American, European, and world championships twice. She won the 1948 Olympic games title, and then became a professional. Miss Scott was born in Ottawa, Ont., Canada. RICHARD G. HACKENBERG

SCOTT, DAVID RANDOLPH (1932-), a United States astronaut, commanded the Apollo 15 mission that made the fourth manned landing on the moon. Scott and astronaut James B. Irwin landed in the lunar module *Falcon* on July 30, 1971, and stayed for nearly 67 hours. Alfred M. Worden, the third crew member, remained in lunar orbit in the command module *Endeavour*. Scott and Irwin explored the moon in the area of a canyon called the Hadley Rille in the Apennine Mountains. They collected about 170 pounds (77 kilograms) of rock and soil samples.

Scott was born in San Antonio, Tex. He entered the Air Force in 1954 after graduating from the U.S. Military Academy. He became an astronaut in 1963. In 1966, he piloted the Gemini 8 mission with astronaut Neil A. Armstrong. Scott served as command module pilot on the Apollo 9 mission in 1969. He left the astronaut corps in 1972. In 1975, Scott became director of the National Aeronautics and Space Administration's Flight Research Center at Edwards Air Force Base in California. WILLIAM J. CROMIE

SCOTT, DRED. See DRED SCOTT DECISION.

SCOTT, DUNCAN CAMPBELL (1862-1947), was a Canadian author. He was an official of the Canadian Department of Indian Affairs and wrote about Indians in his poems and stories. His first volume of poetry, *The Magic House*, appeared in 1893. He also published short stories and biographies of historical figures. He was born in Ottawa, Ont. DESMOND PACEY

SCOTT, F. R. (1899-), is a Canadian poet and legal scholar. He writes witty, satirical poems about man in society. He also writes about man and his relationship to nature. Collections of Scott's poetry include *Overture* (1945), *Events and Signals* (1954), and *Signature*, (1964). He has edited poetry anthologies and has translated French-Canadian literature into English.

Scott is known as an expert in constitutional law. He taught law at McGill University in Montreal for over 30 years and was dean of law from 1961 to 1964. He has been active in politics and has written many articles about Canadian government. Francis Reginald Scott was born in Quebec, Que. CLAUDE T. BISSELL

SCOTT, HUGH DOGGETT, JR. (1900-), a Pennsylvania Republican, became minority leader of the U.S. Senate in 1969. He succeeded Senator Everett M. Dirksen of Illinois after Dirksen's death. Scott, a liberal Republican, won the post in a close contest with Senator Howard H. Baker, Jr., of Tennessee. Baker was Dirksen's son-in-law and the choice of conservative Republican senators.

United Press Int.

Hugh D. Scott

Scott was born in Fredericksburg, Va., and graduated from Randolph-Macon College and the University of Virginia School of Law. He served in the U.S. House of Representatives from 1941 to 1945 and from 1947 to 1959. He was defeated in 1944 but won re-election in 1946. He was chairman of the Republican National Committee in 1948-1949. Scott was elected to the Senate in 1958 and re-elected in 1964 and 1970. DAVID S. BRODER

SCOTT, ROBERT FALCON (1868-1912), an English explorer and naval officer, became the first man to reach the South Polar plateau. He reached it on an expedition that took place from 1901 to 1904.

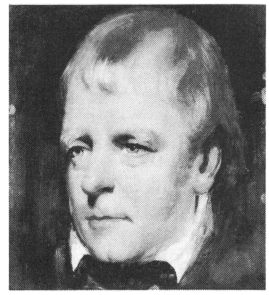
Scott sailed in 1910 from New Zealand on the *Terra Nova* in an attempt to reach the true South Pole. The party reached Cape Evans on Ross Island, and set up headquarters there. Scott started over the ice with sledges in November, 1911. Snowstorms made his progress slow and difficult, but finally conditions improved. The men reached the Pole on Jan. 18, 1912, but they found that Roald Amundsen, a Norwegian explorer, had already reached it only a month before. On the return trip, all five members of the party died from hunger and cold. Three bodies, as well as records and diaries the men had kept, were found at their last camping place. Scott had written his journal up to the day of his death. He wrote what he considered to be the causes of their disaster. Scott was born in Devonport. JOHN EDWARDS CASWELL

United Press Int.

Robert Scott

See also ANTARCTICA (Exploration; map; picture).

SCOTT, SIR WALTER (1771-1832), was a Scottish romantic writer. He created and popularized historical novels in a long series of works called the *Waverley* novels. In such novels as *Ivanhoe*, *The Heart of Midlothian*, and *The Talisman*, Scott showed his unique genius for recreating social history. He arranged his plots and characters so the reader can enter into the lives of both great and ordinary people who were caught up in violent, dramatic changes in history.



Portrait by Sir John Watson Gordon. The National Galleries of Scotland, Edinburgh

Sir Walter Scott

Scott's art shows the influence of the Enlightenment of the 1700's. He believed every human was basically decent, regardless of his class, religion, politics, or ancestry. Tolerance for different ways of life is a major theme in his historical works. The *Waverley* novels express his belief in the need for social progress that does not reject the traditions of the past. He was the first novelist to portray peasant characters sympathetically and realistically. He was equally just to businessmen, professional soldiers, and even kings.

Scott's amiability, generosity, and modesty made him popular with his fellow writers. He declined the offer of poet laureate in 1813 and supported Robert Southey, who received the honor. Scott entertained on a grand scale at Abbotsford, his famous estate.

Scott's influence can be seen in the works of Victor Hugo and Honoré de Balzac of France, James Fenimore Cooper of the United States, and Leo Tolstoy of Russia. But despite his influence, Scott's reputation declined from the late 1800's to the mid-1900's. His reputation has begun to rise again. But it probably will never reach the heights it attained during Scott's lifetime, when Goethe exclaimed, "All is great in the *Waverley* Novels: material, effect, characters, execution." Literary historians regard Scott's death in 1832 as marking the close of the romantic age in English literature.

His Life. Scott was born in Edinburgh. His father, a successful lawyer, had young Walter trained for a law career. Scott became an attorney in 1792 and practiced actively for many years.

A childhood illness, probably polio, left Scott lame in his right leg. But he had unusual physical strength, and was an enthusiastic outdoorsman. He enjoyed taking trips into the Scottish countryside. These trips gave him firsthand knowledge of the life of rural people, and provided material for his first major publication *Minstrelsy of the Scottish Border* (1802-1803). This book was one of the great early collections of popular songs and ballads. *Minstrelsy* led to his first long verse poem *The Lay of the Last Minstrel* (1805). The poem tells the legend of a famous goblin, and describes much about life along the English-Scottish border in the 1500's.

Scott continued his success at narrative poetry with *Marmion* (1808), which includes his best-known ballad "Lochinvar" (see LOCHINVAR). In 1810, Scott wrote his most popular story-poem, *The Lady of the Lake.* This romantic tale, set in the famous Trossach Mountains, deals with picturesque Highland customs and history.

The Waverley Novels. From the publication of his first novel *Waverley* in 1814, Scott devoted himself primarily to fiction. Scott's progress to historical novels was natural. His talents as a storyteller and as a creator of character, as well as his gift for realistic Scottish dialect, could never find full expression in poetry.

Waverley describes a Scottish rebellion against England in 1745. It was published anonymously, without the benefit of Scott's name. Yet it was a success. From 1814 to 1832, Scott published 27 other novels, four plays, and much nonfiction. All of his novels were referred to as part of the *Waverley* series, because the author was identified on the title page as "The Author of *Waverley*." Scott's authorship was officially revealed in 1827, but it had been known for years.

Scott wrote frequently about the conflicts between different cultures. *Ivanhoe* (1819) deals with the conflict between Normans and Saxons, and *The Talisman* (1825) describes the conflict between Christians and Moslems. The novels dealing with Scottish history are probably Scott's best. They deal with the conflict between the new commercial English culture and an older Scottish culture. Scott contrasts the earthy vividness of the Scottish peasants with the formal, stilted language of his English-speaking, upper-class characters. Many critics consider *The Heart of Midlothian* (1818) Scott's best novel. It takes place in Edinburgh in the early 1700's. *The Antiquary* (1816) and *Redgauntlet* (1824) are partly autobiographical. Scott's other novels in the *Waverley* series include *Old Mortality* (1816), *Rob Roy* (1817), *A Legend of Montrose* (1819), and *Quentin Durward* (1823).

KARL KROEBER

SCOTT, WINFIELD (1786-1866), an American Army officer for more than 50 years, served in the War of 1812, the Mexican War, and the beginning of the Civil War. His men affectionately called him "Old Fuss and Feathers" because he loved colorful uniforms.

Scott was born near Petersburg, Va. He attended William and Mary College and then studied law. He gave up law in 1808 to join the U.S. Army.

When the War of 1812 broke out, he became a lieutenant colonel and went to the Canadian border. Scott was captured at the Battle of Queenston Heights, but he was freed a month later. As a colonel, he carried out a successful attack on Fort George and took charge of that post. He became a brigadier general in March, 1814, and fought at Chippewa and Lundy's Lane. Two horses were shot from under him at Lundy's Lane. He fought on so stubbornly that he had to be carried from the field, severely wounded (see WAR OF 1812 [Chief Battles of the War]). He became a national hero, and Congress and the State of Virginia voted him a medal. He was a major general when the war ended.

In 1825, Scott prepared the first complete manual of military tactics in the U.S. Army. He also enlarged *Infantry Tactics* (1835), and wrote his autobiography in 1864. He became general in chief of the Army in 1841, and lieutenant general in 1844.

Brown Bros.

Winfield Scott

In the Mexican War, in 1847, he led an army into Mexico. He won at Veracruz, Cerro Gordo, Contreras, Churubusco, Molino del Rey, and Chapultepec, and he captured Mexico City (see MEXICAN WAR [Scott's Campaign; Principal Battles]). He ran for President of the United States in 1852 on the Whig ticket but he lost to the

Democratic presidential candidate, Franklin Pierce.

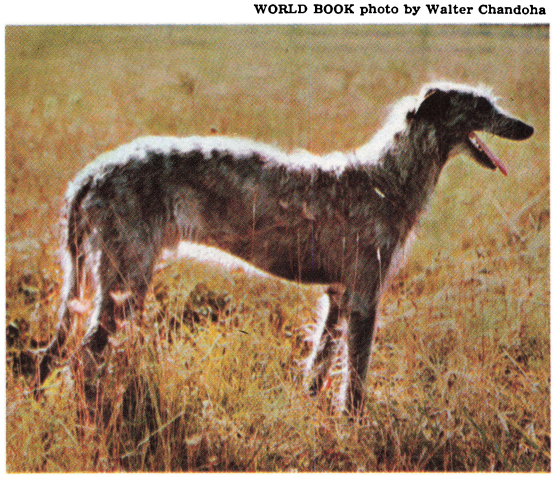
Early in 1861, Scott went to Washington, where he recruited men to defend the capital. When the Civil War began in April, Scott, a Southerner, refused to join the Southern forces, because he believed in the Union. He retired from the Army in 1861. JOHN R. ALDEN

SCOTT AIR FORCE BASE, Ill., is the headquarters of the U.S. Military Airlift Command (MAC). The 2,300-acre (931-hectare) base lies about 6 miles (10 kilometers) east of Belleville. The base was a training center in World Wars I and II and was once the headquarters of the Air Training Command. It was established in 1917 and named for Corporal Frank S. Scott, the first enlisted man to die in an air accident. See also MILITARY AIRLIFT COMMAND. RICHARD M. SKINNER

SCOTTIE. See SCOTTISH TERRIER.

SCOTTISH DEERHOUND was for hundreds of years a dog of the peerage. In Scotland, only persons with the rank of earl or higher could own deerhounds. The dog stands from 30 to 32 inches (76 to 81 centimeters), or even taller. It weighs from 75 to 110 pounds (34 to 50 kilograms). Its wiry coat is dark blue-gray, light gray, brindle, yellow, sandy red, or fawn red. Scottish lords bred the dog to hunt wild deer, but in America it is used for hunting wolves. The deerhound makes a good companion. OLGA DAKAN

The Scottish Deerhound Was Bred to Hunt Wild Deer.
WORLD BOOK photo by Walter Chandoha



SCOTTISH EPISCOPAL CHURCH. See CHURCH OF ENGLAND.

SCOTTISH RITE. See MASONRY (The Lodges).

SCOTTISH TERRIER is a breed of dogs first raised in the Scottish highlands in the 1800's. Commonly called "Scottie," it is the only breed with the official name of Scottish terrier. But the cairn, Skye, and West Highland white terriers are also native to Scotland. The Scottish terrier is a small dog with short legs and a chunky body, weighing 18 to 22 pounds (8 to 10 kilograms). It has a hard wiry coat and a long head with small upright ears. It may be black, wheat, sandy, steel gray, or brindle. The Scottish terrier is brave. It hunts rats and other small animals. See also DOG (color picture: Terriers). JOSEPHINE Z. RINE

SCOTTS BLUFF NATIONAL MONUMENT is in western Nebraska. Established in 1919, it is a landmark on the Oregon Trail. It has a museum of historical relics and fossils. The 3,084.00-acre (1,248.05-hectare) area rises to an elevation of 4,649 feet (1,417 meters). See also NEBRASKA (picture: Mitchell Pass).

SCOTTSDALE, Ariz. (pop. 67,823), is the third largest city in Arizona. Only Phoenix and Tucson have more people. Scottsdale lies just northeast of Phoenix. For location, see ARIZONA (political map). Scottsdale's warm climate makes it a popular winter resort center.

Major Winfield Scott, a Union Army chaplain during the Civil War, founded the city in 1895. Scottsdale was an agricultural community until after World War II ended in 1945. During the next two decades, the construction of electronics equipment factories in the area helped Scottsdale's population grow. Scottsdale became one of Arizona's fastest-growing communities and attracted many artists and craftsmen. Its population increased about 500 per cent during the 1950's and 600 per cent in the 1960's. Scottsdale received a city charter in 1961.

Part of Scottsdale resembles an old frontier town. This section gives the city its nickname, *The West's Most Western Town*. Scottsdale has a city manager form of government. GERALD R. MCELFRESH

SCOTUS. See DUNS SCOTUS, JOHN.

SCOURING RUSH. See HORSETAIL.

SCOUT. See BOY SCOUTS; GIRL SCOUTS.

SCOUT. The first explorers of the American frontier were usually fur traders. They knew the Indian tribes, found mountain passes, and located camping places. These experienced frontiersmen served as scouts to guide colonial armies. The first settlers to Oregon and California also employed fur traders as guides. The U.S. Army used friendly Indians as scouts. One of the best-known scouts was Kit Carson (see CARSON, KIT).

SCOW. See BARGE; SAILING (Kinds of Sailboats).

SCRANTON, Pa. (pop. 103,564; met. area 621,858), is the largest city in Pennsylvania's anthracite region, and one of the largest cities in the state. The Scranton region once depended solely on coal, but mining has declined. Scranton has become a center for the manufacture of textiles, appliances, shoes, cigars, and electronic equipment. Its name comes from the Scranton family, which founded an iron works there in 1840.

Scranton lies in northeastern Pennsylvania, 134 miles (216 kilometers) from New York City (see PENNSYLVANIA [political map]). The city stands in a valley closely bordered by ridges of the Allegheny Mountains. It is a short distance from the Pocono Mountains resort area.

Scranton is the home of the International Correspondence Schools. Also located in Scranton are the University of Scranton, Marywood College, and a Pennsylvania State University extension school.

Scranton has a large wholesale and retail trade. Besides coal, the city produces heating and air conditioning equipment, textile machinery, bathtubs, caskets, stokers, plastic products, and paints and varnishes. Other products include books, clothing, lamps, condensers, paper boxes, and phonograph records.

The first settlers came in the 1780's. Scranton became a borough in 1853, and a city in 1866. It is the seat of Lackawanna County. Scranton has a mayor-council form of government. S. K. STEVENS

SCRANTON, WILLIAM WARREN (1917-), was the governor of Pennsylvania from 1963 to 1967. He campaigned for the Republican presidential nomination in 1964, but lost. He did not begin his campaign until most of the states had pledged their convention votes to Senator Barry M. Goldwater.

Scranton was born in Madison, Conn. He studied law at Yale, and served as an Army flier in World War II. After the war, he built a successful business career, and worked to develop Scranton, Pa. The city is named for his family. Scranton served briefly in the U.S. Department of State. He served in the U.S. House of Representatives from 1961 to 1963. In 1970, President Richard M. Nixon named Scranton to head the President's Commission on Campus Unrest. The commission explored the causes and consequences of disturbances at the nation's colleges and universities. ERIC SEVAREID

SCRAP IRON. See IRON AND STEEL (The "Recipe" for Making Steel; picture: Why Collecting Scrap Iron Is Important).

SCREEN, PROJECTION. See PROJECTION SCREEN.

SCREEN PROCESS PRINTING. See PRINTING (Other Printing Processes).

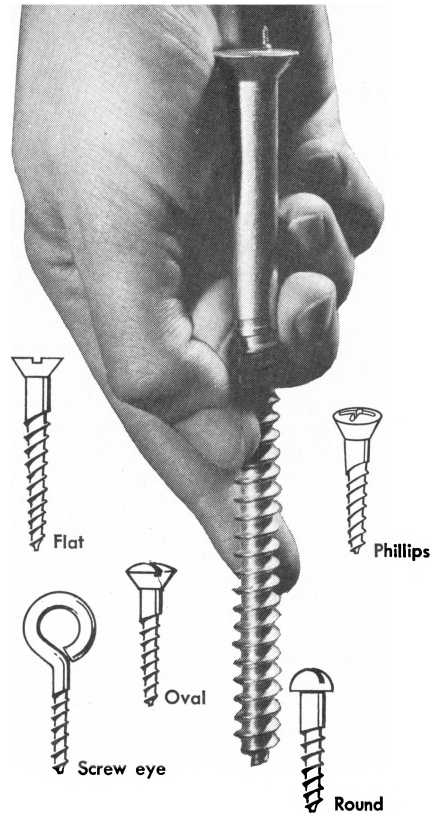
SCREW is an inclined plane wrapped around a cylinder or a cone (see INCLINED PLANE). Scientists and engineers classify the screw as a *simple machine*. A screw has two main parts. The spiral part that sticks out from the cylinder or cone is called the *thread*. The cylinder or cone itself is called the *body*. The center line of the body is called the *axis*. As the screw rotates one full turn, the object in contact with the thread moves along the axis. It travels from crest to crest of the thread. The distance between the crests is called the *pitch*. The movement along the axis per revolution is called the *lead* (pronounced *leed*) of the screw. If the thread consists of only one spiral, the lead and the pitch are identical. If a screw has 10 threads for every inch, both the pitch and the lead will measure $\frac{1}{10}$ of an inch. But some screws have two separate threads that start on opposite sides of the body. If the thread consists of two spirals, the lead is twice as large as the pitch.

The Principle of the Screw. The main purpose of the screw is to raise a load over the threads of the screw by applying a small force. The distance moved by a point on the screw as it turns is called the *circumference* of the screw. The work done per revolution equals the force applied at a tangent to the screw times the circumference. Therefore work (W) equals $F \times 2\pi r$, where F equals the force, and $2\pi r$ equals the circumference.

A screw always offers a certain amount of *resistance* due to friction, since the surfaces of the thread can never be made perfectly smooth. The resistance is a force opposite to the force applied to the machine. The resistance means that a somewhat larger force than the F in the formula must be applied.

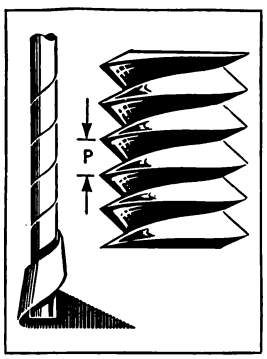
Engineers sometimes desire to find out how heavy a load can be raised by a certain amount of force. They figure this by multiplying the force by the circumference of the screw. Then, the engineers divide this product by the lead. The formula for this is $L = \frac{F \times 2\pi r}{l'}$, where L stands for load, F for force, r for radius, and l' for lead.

Uses. Screws have many practical uses. The screws most widely used are wood screws and machine screws.



Popular Science Monthly

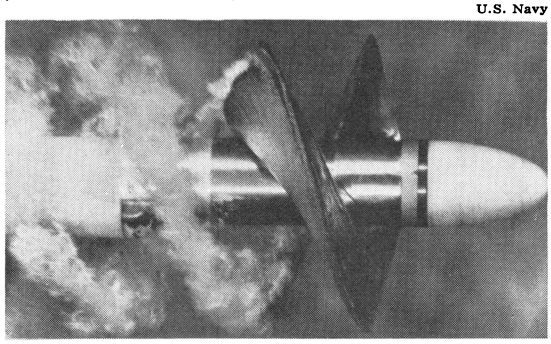
A Large 6-Inch Screw, *above,* is more than 25 times as long as the tiny screw resting on its head. It takes about 10,000 of the small screws, but only 5 large ones, to weigh a pound.



The Screw is an inclined plane, spirally wound around a center pole. A strip of paper wrapped around a tube, *left,* illustrates this. The letter *P* shows the screw's *pitch* (distance between the threads).

A Supercavitating Propeller, *below,* will greatly increase a ship's speed. This new screw-type propeller is not slowed by *cavitation* (vacuum pockets that form around conventional propellers). It bites into water just as a screw bites into wood.

U.S. Navy



SCREW, ARCHIMEDEAN

Wood Screws and Machine Screws are made of steel, copper, aluminum, and other material that is easy to form. They are usually made by automatic screw machines that make several thousand screws an hour. Screws come in all sizes and shapes, depending on their uses. Screws are often inserted through a hole in a flat disk called a *washer*. The washer keeps the screw from damaging the material on which it is used. Some screws come with the washer attached. *Lockwasher* screws have a washer with a bent or toothed edge. When the screw is driven in, the lockwasher creates friction between the screw and the surface on which it is used. This friction helps to hold the screw in place. Many industries use a large number of *self-tapping* screws, which make a separate small thread inside a hole. The surface of self-tapping screws creates a large amount of friction, and eliminates the need of fastening devices, such as nuts, to hold them in place. Self-tapping screws are used in automobile and truck bodies and in all types of home appliances.

Other Uses. Screws also open and close nearly all vises. *Jackscrews* raise heavy buildings and hold heavy weights in position. The *micrometer*, which measures small distances with great accuracy, works by means of a screw that has fine threads (see MICROMETER). Screws also produce motion. An airplane propeller is an *air screw*. A ship propeller is a *water screw*. ALLEN S. HALL, JR.

See also BOLT; PROPELLER.

SCREW, ARCHIMEDEAN. See ARCHIMEDEAN SCREW; ARCHIMEDES.

SCREWWORM. See BLOWFLY.

SCRIABIN, *skree AH bin*, or *SKRYAH byin*, **ALEXANDER** (1872-1915), a Russian composer and pianist, became known for his experiments in using harmony as melody. His last six sonatas for piano, written between 1908 and 1913, are considered masterworks. He was influenced by literary ideas and mystic visions, and he composed *The Divine Poem* (1905), *Poem of Ecstasy* (1907), and *Prometheus, the Poem of Fire* (1909-1910) for large orchestra.

His smaller pieces for piano, including etudes, preludes, and impromptus, show his romanticism. Scriabin won fame as a concert pianist, and toured the United States in 1906. He toured Russia with Serge Koussevitzky between 1908 and 1910. Scriabin was born in Moscow. He studied at the Moscow Conservatory, and later taught piano there. JOYCE MICHELL

SCRIBE was an official who wrote books by hand before printing was invented. Kings usually kept scribes at court to copy manuscripts and write official letters and documents.

A scribe's work was slow and painstaking. A nobleman in Florence, Italy, once had 45 scribes copy books for his private library. At the end of two years of copying, the nobleman's scribes had produced only about 200 books.

In many parts of the world today, thousands of people still do not know how to write. They depend on scribes to do all their writing. In Istanbul, Turkey, scribes work in public places, such as the courtyards of mosques. They sit at little tables and write letters or documents that people dictate.

In Biblical times, scribes were called *sopherim*. Early scribes were men who copied the *Torah*, or Law. Later, the scribes developed into a class of learned men who taught and interpreted the Scriptures, and kept charge of official documents. The scribe Ezra became the leader of the Jews who returned to Judea after the Babylonian Exile. In the time of Jesus, the scribes were called *doctors of the law*. Some scribes held classes to train rabbis. Paul's teacher, Gamaliel, was a scribe. In Matthew 23: 13-33 Jesus rebuked the "scribes and pharisees."

Today, trained scribes still write the scrolls of the Torah used in synagogues. They wear special ritual robes while at work. A scribe must be a pious man with a thorough knowledge of Hebrew. WILLIAM F. ROSENBLUM

See also EZRA; HANDWRITING; MANUSCRIPT; PHARISEE.

Saint Luke Was a Learned Scribe. He is shown in this Flemish painting at work drawing a picture of the Virgin.

Newberry Library

SCRIBE, *skreeb*, **AUGUSTINE EUGÈNE** (1791-1861), was a French dramatist. His name is associated with the phrase "the well-made play," which means a play that is valued more for its plot complications and thrills than for its thought. He wrote *A Glass of Water* (1820), which deals with intrigues at the English court. His best-known serious play was the tragedy *Adrienne Lecouvreur* (1849). He often worked with other writers, and it is believed he wrote more than 400 dramatic pieces. He was born in Paris. JOHN W. GASSNER

SCRIBNER was the family name of two American book publishers, father and son. Charles Scribner, Sr. (1854-1930), and Charles Scribner, Jr. (1890-1952), were the second and third members to head the Scribner

publishing firm since its founding in New York City in 1846. Charles Scribner, Sr., reorganized his father's company into Charles Scribner's Sons in 1878. Under his direction and that of his son, the firm published works which helped to make many authors famous. Both Scribners were born in New York City. I. W. COLE

SCRIMMAGE, LINE OF. See FOOTBALL (The Players).

SCRIPPS, EDWARD WYLLIS (1854-1926), was a famous American journalist. He started the first newspaper chain and founded the United Press Associations, now United Press International. He controlled a large number of newspapers and newspaper services.

Scripps was born on a farm near Rushville, Ill. At the age of 18, he started to work on the *Detroit Tribune* as an office boy. Six years later, he began a newspaper of his own, the *Cleveland Penny Press*. This paper was the first of a chain that included papers from the Middle West to the Pacific Coast. Scripps and his brothers bought the *St. Louis Evening Chronicle* in 1880. Two years later, they purchased the *Cincinnati Penny Post*, which they later renamed the *Cincinnati Post*.

Scripps' health failed in 1917, and he gave control of his newspaper holdings to his son, Robert P. Scripps. In 1922, the chain became known as the Scripps-Howard Newspapers, Inc. JOHN ELDRIDGE DREWRY

See also UNITED PRESS INTERNATIONAL.

SCRIPPS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SCRIPPS INSTITUTION OF OCEANOGRAPHY is a graduate research institution in La Jolla, Calif., for the study of ocean geography and related sciences. Research projects include the topography and composition of the ocean bottom, the properties of water, waves, currents, and tides, and marine biology. The institution is a part of the University of California, San Diego. It was founded in 1903 as a marine biological station. It received its present name in 1925.

Critically reviewed by SCRIPPS INSTITUTION OF OCEANOGRAPHY

SCRIPT. See TYPE; WRITING (Scripts).

SCROD is a young codfish cut into strips across the grain in preparation for cooking. In the United States, the term *scrod* is sometimes used to mean various other young fish as well as cod. See also COD.

SCROFULA, *SKRAHF yoo luh*, is a form of tuberculosis that attacks the lymph glands, and sometimes the bones and joints. Usually, the lymph glands in the neck are affected. Infected bones and joints become swollen and may break down, causing pus to form. The infection usually occurs in young people. Treatment consists of sunlight, fresh air, good food, and warm and suitable clothing. Physicians may prescribe cod-liver oil and similar tonics. An operation may be necessary to provide drainage when an abscess forms.

In England, scrofula was formerly called *the king's evil*, because many people believed that a victim could be healed if the king touched him. The practice is supposed to have originated with the Anglo-Saxon king, Edward the Confessor, and to have died out during the 1800's. See also FIGWORT FAMILY; TUBERCULOSIS; ANNE (picture). HYMAN S. RUBINSTEIN

SCROLL is a roll of paper, parchment, or other material. Many ancient peoples used scrolls as books. The Egyptians used papyrus for writings and illustrations. The Greeks and Romans used papyrus, and parchment or other skins. They rolled these materials around rods of wood, ivory, or bronze to form scrolls. They usually decorated the rods at both ends with small knobs or other ornaments. This protected the scrolls and made them easier to handle. The Hebrews have always used scrolls for their sacred writings.

Barry, Three Lions

The *Torah* Is Written on a Large Scroll, above. It is made up of the first five books of the Bible.

The Chinese and Japanese use scrolls made from such materials as silk or paper. They use these scrolls both for paintings and for writings. When the scrolls are rolled horizontally, they are called *makemono*. When rolled vertically, they are called *kakemono*.

The design called *scroll* or *scrollwork* is a curving design suggested by the appearance of the end of a loosely wound scroll. WILLIAM M. MILLIKEN

Related Articles in WORLD BOOK include:

Bible (picture)
Book (picture)
Dead Sea Scrolls
Manuscript
Mythology (picture: Osiris)
Painting (Oriental Painting [pictures])
Papyrus

SCROOGE. See DICKENS, CHARLES (The First Phase).

SCRUPLE, *SKROO puhl*, is a unit of apothecaries' weight, a system of weights once widely used in drug measurement. The scruple is equal to 20 grains, or 1,296 grams.

SCUBA DIVING. See SKIN DIVING (Kinds of Skin Diving); DIVING, UNDERWATER (Free Diving); OCEAN (pictures).

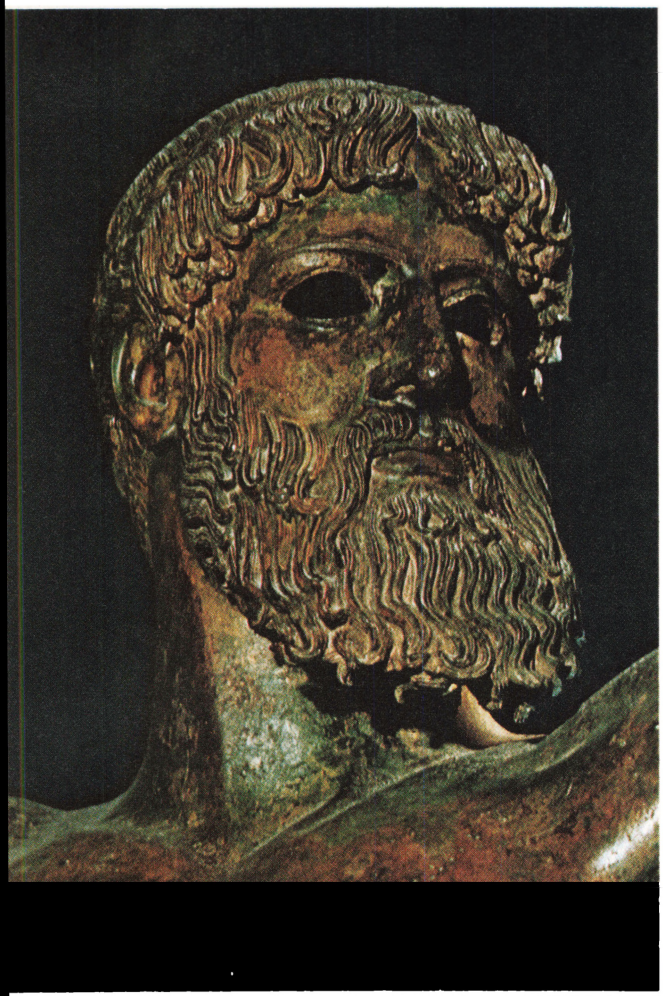
SCULL. See ROWING.

SCULPIN is a family of fishes that have large mouths, large heads, and bodies that taper sharply to the tail fin. They live in many parts of the world. Most of them live near rocky shores. Some, however, live in deep parts of the ocean, and others live in fresh, inland water.

Most sculpins have spiny heads and fins and warty skins. People in the Arctic regions eat them, although these fish have little flesh and many bones. The sculpins eat small sea animals, and have greedy appetites. They often steal the bait from fishermen's hooks. Sculpins are eaten by larger fish. They are also called *blob*, *bullhead*, *miller's-thumb*, and *tide-pool johnny*.

Scientific Classification. Sculpins make up the sculpin family, *Cottidae*. LEONARD P. SCHULTZ

SCULPTURE



Archaeological Museum, Athens; photo by Raymond V. Schoder, S.J.

A Greek god, either Poseidon or Zeus (detail)
Greece, about 460 B.C. Bronze. Figure 6 ft. 10 in. (2.08 m) high.

Museum of Fine Arts, Boston; WORLD BOOK photo by Robert Crandall

The Hindu goddess Durga
India, A.D. 600's. Stone. 4 ft. 11 in. (1.50 m) high.

SCULPTURE is one of the most interesting and complex of man's arts. It ranges from Michelangelo's powerful carvings to African masks worn in religious ceremonies, and from stone statues that decorate cathedrals to metal mobiles that sway gracefully in the air.

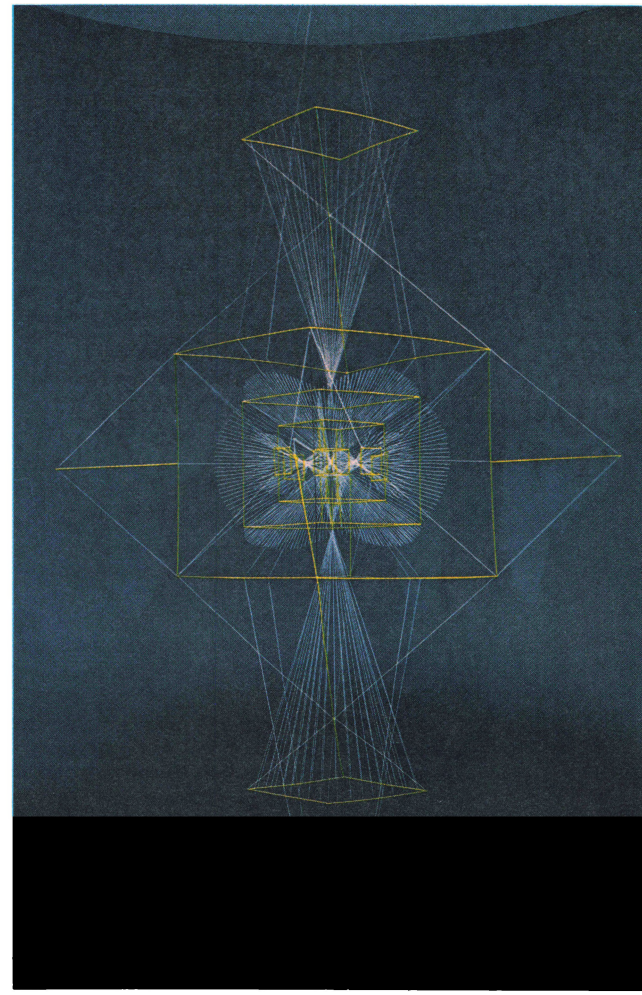
A piece of sculpture can be small enough to stand on a table, or as large as the Statue of Liberty. But whether large or small, sculpture tends to have a *monumental* quality—the quality of grandeur and nobility in a work of art. Large-scale sculpture is often called monumental because of its size. Yet even the smallest sculpture can express noble and grand ideas.

The art of sculpture probably developed in association with religious and magical practices. The oldest known sculptures were created more than 30,000 years ago, during the Paleolithic Period (Old Stone Age). Prehistoric men carved small *amulets* (charms) and idols from such materials as bone or ivory. They probably

The contributors of this article are Mulk Raj Anand, former Chairman of the National Academy of Art, New Delhi, India; John Boardman, Reader in Classical Archaeology at Oxford University and author of Greek Art; *Douglas Fraser, Professor of Art History and Archaeology at Columbia University and author of* Primitive Art; *H. D. Molesworth, author of* European Sculpture *and former Keeper of Sculpture and Woodwork, Victoria and Albert Museum, London; Bernard Myers, Tutor at the School of Industrial Design of the Royal College of Art, London, and author of* Sculpture: Form and Method; *Sir Herbert Read, author of* The Art of Sculpture; *and Allen S. Weller, former Director of the Krannert Art Museum at the University of Illinois. The article was critically reviewed by Sir Herbert Read.*

WORLD BOOK photo by Leonard von Matt

West portals of Chartres Cathedral (detail)
France, about 1150. Stone. Figures 20½ ft. (6.25 m) high.



The Museum of Modern Art, New York

Variation Number 7: Full Moon by Richard Lippold
1949-1950. Brass rods, nickel-chromium and stainless steel wire. 10 ft. (3.05 m) high.

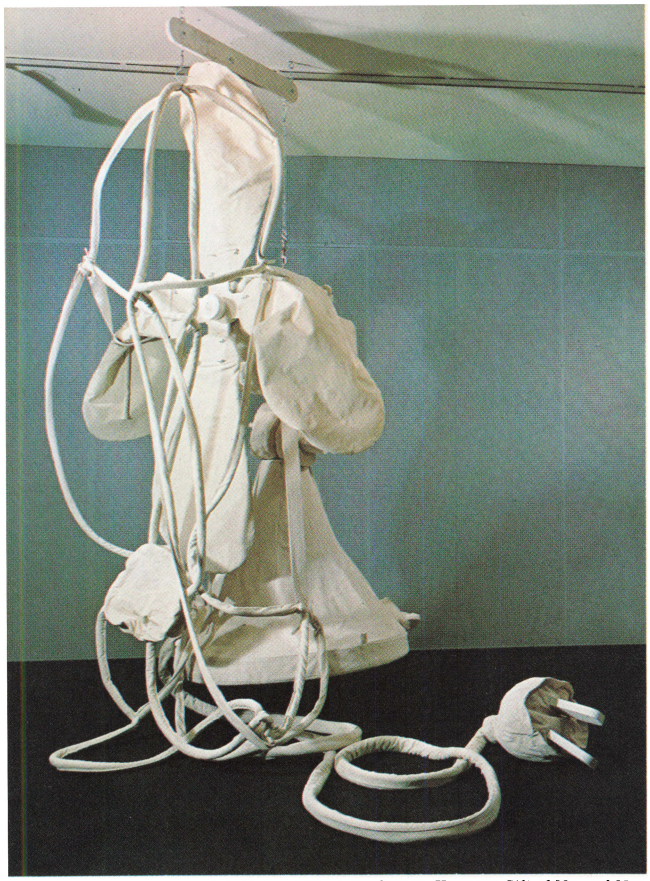
used these carvings in connection with their burial or fertility ceremonies. They modeled similar objects in clay. Although the word *sculpture* originally meant *cut* and implied the technique of carving, modeled objects are also called sculpture.

The Importance of Sculpture

As a Record of History. No art presents a more complete or clearer record of the development of human culture than sculpture. Sculpture can tell us much about the way of life of a particular people or period by physically representing the ideas and ideals of a civilization. For example, the ancient Greeks and the people of the Middle Ages both idealized the human form in their sculptures, and showed the human body as they felt it should look. The Greeks admired man and his works, and they tried to make the human form as perfect as possible in such sculptures as the bronze statue of the *Greek god Poseidon* or *Zeus*, shown on the opposite page. During the Middle Ages, people were more concerned with life after death than with life on earth. Medieval sculptors made the human form longer and thinner than it really is. They did this to represent an ideal view of a spiritual world, as in the long, narrow figures that decorate the *west portals of Chartres cathedral*. These figures, shown on this page, represent characters from the Old Testament.

The Aztecs of Mexico created a grim, sacrificial art dominated by religious ideas. *Xolotl, an Aztec death god*, shown on page 194, appears as a skeletal figure because the Aztecs believed that he, in the form of an evening star, guided the dead through the underworld.

In India, China, and other Oriental civilizations, sculpture is used to aid contemplation. Such Oriental



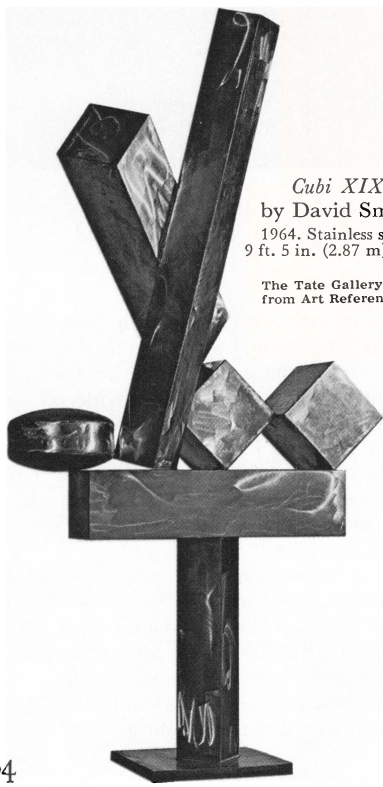
The University of St. Thomas, Houston; Gift of Mr. and Mrs. John de Menil; Courtesy Sidney Janis Gallery, New York

Giant Soft Fan, Ghost Version by Claes Oldenburg
1967. Canvas, wood, and foam rubber. 10 ft. (3.05 m) high.

religions as Buddhism and Hinduism stress the eternal, invisible powers of the universe rather than the temporary, observable realities of the everyday world. Through contemplation of sculptured images, Oriental peoples seek to understand these divine powers and to become united with the eternal. Indian sculptures that decorate Hindu temples show the Indian desire to contemplate the mythical acts of the gods. The stone carving of the *Hindu goddess Durga*, shown on page 192, represents the goddess engaged in a legendary drama that teaches salvation.

Some modern artists create sculptures that comment on the ideas and ideals of their society. The American sculptor Claes Oldenburg seems to satirize present-day society's dependence on machines, mechanical objects, and gadgets. In such works as *Giant Soft Fan*, *Ghost Version*, he uses electrical fixtures, typewriters, bathroom plumbing, and other mechanical devices. Oldenburg constructs these forms out of canvas or some other limp fabric, which transforms them into mysterious objects that disturb the viewer.

Sculpture does more than reflect the religious, moral, and social values of a society. It can also create a record of the everyday life of a particular era. Much of our knowledge about the ancient cultures of Egypt, Assyria, and America comes from their works of sculpture. The linen clothing portrayed in the sculpture *Egyptian Soldiers Leading Prisoners* tells us that the Egyptians



Cubi XIX
by David Smith
1964. Stainless steel.
9 ft. 5 in. (2.87 m) high.

The Tate Gallery, London, from Art Reference Bureau

Xolotl, an Aztec death god
Mexico (Aztec style), A.D. 1324-1521. Jade. 11 in. (28 cm) high.
Linden-Museum, Stuttgart, Germany; loan gift of Württembergisches Landesmuseum, Stuttgart, from Art Reference Bureau

Rijksmuseum van Oudheden, Leiden, The Netherlands, from Art Reference Bureau

Egyptian Soldiers Leading Prisoners

Fragment of a relief from the tomb of the Egyptian king Horemheb. Egypt (Dynasty XVIII), about 1330 B.C. Limestone. 24½ in. (62 cm) wide.

Diego Rivera Museum, Tepetlápan, Mexico; WORLD BOOK photo by Omar Marcus

Model of a ball court with spectators

Western Mexico (Nayarit style), about A.D. 100-600. Clay. About 12 in. (30 cm) high.

were farmers who grew cotton and flax, rather than herdsmen who produced wool. The artists of western Mexico constructed delightful scenes in clay that illustrate various ceremonies and other aspects of village life. The *model of a ball court with spectators* represents a game known from the Arizona region to the Caribbean. The purpose of the game was not merely entertainment. The ball game was also a ceremony that re-enacted the daily disappearance of the sun into the underworld, and implied the sun's return. Thus, the ball game was a symbol of the renewal of the universe.

As Monuments and Memorials. Because sculpture can be created from such long-lasting materials as stone or metal, it is the art most suitable for monuments and memorials. This type of sculpture is called *commemorative* sculpture. In Western civilizations, most commemorative sculpture represents important persons or great events. For example, the Italian Renaissance sculptor Andrea del Verrocchio designed the bronze *equestrian monument of Bartolommeo Colleoni* in honor of a famous Italian general. In Russia, where people of many cultures are under Soviet rule, commemorative sculpture has an additional purpose. The Russian government uses such war memorials as *The Motherland* by Yevgeny Vuchetich as landmarks to give the people a sense of belonging to one culture (page 196).

As Artistic Expression. Many artists create sculpture to satisfy their creative need to communicate, to express their own ideas and feelings, or simply to create an object of beauty. When we look at a piece of sculpture, we can ask ourselves: "What is the sculptor saying in this work?" or "Why do I find this work beautiful, profound, or disturbing?"

Much modern sculpture is created partly to satisfy the sculptor's desire to experiment with new forms and

Piazza di SS. Giovanni e Paolo, Venice; WORLD BOOK photo by Leonard von Matt

Equestrian monument of Bartolommeo Colleoni by Andrea del Verrocchio

Italy, 1479-1488; pedestal by Alessandro Leopardi, 1496. Bronze. Figures over life size.

Novosti Press Agency, Moscow

The Motherland by Yevgeny Vuchetich

Part of a memorial, made up of several sculptures, in honor of the heroes of the Battle of Stalingrad. Volgograd (formerly Stalingrad), Russia, 1967. Reinforced concrete. About 270 ft. (82.30 m) high.

WORLD BOOK photo by Dhiraj Chawda

Kailasanatha Temple

Ellora, India, about A.D. 750-850. Carved out of solid rock.

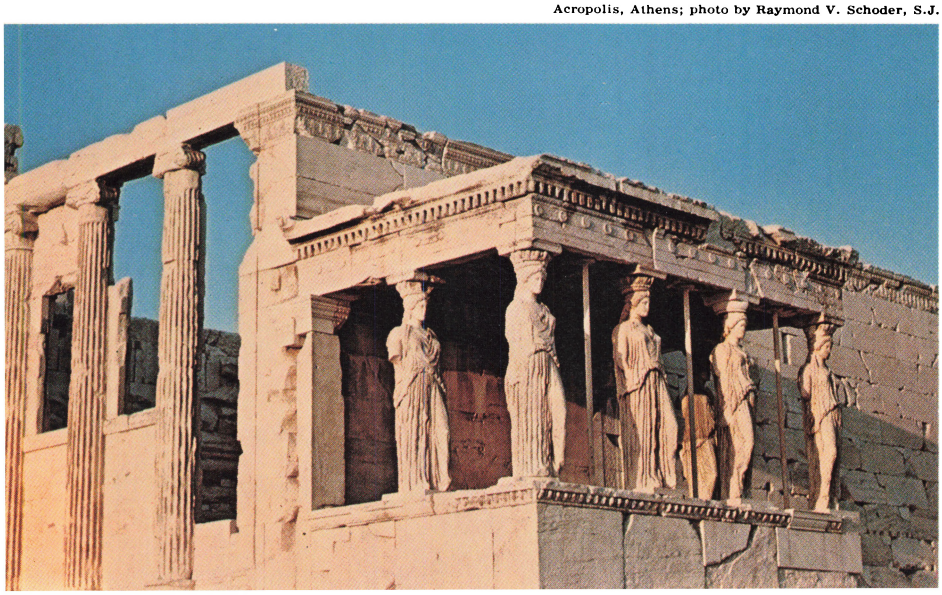
materials. Many sculptors are more interested in pure form—that is, the physical shapes of sculptured works—than they are in the communicative content of their sculptures. For this reason, many modern sculptures are *abstract* or *non-representational* in style. Modern sculptors often use stainless steel, plastics, aluminum, glass, or other industrial materials. They try to develop the unique qualities and emphasize the beauty of these materials, as the American sculptor Richard Lippold did in *Variation No. 7: Full Moon*, a beautiful geometrical construction of tightly stretched wire (page 193). David Smith, another American sculptor, worked mainly with metals in *Cubi XIX* and other sculptures. He expressed the natural qualities of these materials with imagination and originality (page 194).

As Part of Architecture. Throughout history, sculpture has been closely associated with architecture, partly because similar materials and skills are used in both fields. In the temples of the Middle East, India, and ancient Greece and Rome, and in the cathedrals of the Middle Ages, the forms of the buildings blend completely into sculpture. This blending can be seen in the heads and bases of columns, the moldings around doors and along the edges of roofs, and the abstract decorations. In some cases, including the *Kailasanatha temple* at Ellora, India, the temple itself was carved out of solid rock. All these features show that the stonemason's carving skill approached that of a sculptor.

Greek sculptors took particular care in applying sculpture to their temples. They made it blend so well with the architecture that the sculpture was not purely decorative. The Greeks carved their works on panels and *friezes* (horizontal bands) on the sides of buildings, on *metopes* (rectangular areas above columns), and on *pediments* (the triangular ends of a sloping roof).

Some sculpture which is part of the structure of a building also performs a function. Sculptures of the human figure, for example, have been used as columns. Greek sculptors made draped female figures called *caryatids* which support the roof of the south porch of the *Erechtheum* on the Athens Acropolis. Many medieval cathedrals are decorated with grotesque figures called *gargoyles* which serve as water spouts.

Acropolis, Athens; photo by Raymond V. Schoder, S.J.



Caryatids from the south porch of the Erechtheum

Greece, about 421-405 B.C. Marble. Figures 7½ ft. (2.29 m) high.

SCULPTURE / *The Sculptor at Work*

Carving and modeling have been the basic techniques throughout most of the long history of sculpture. In carving, a sculptor works with a solid block of wood, stone, or some other material. He visualizes the finished figure, and then cuts and chips away the material until only the figure as he imagines it remains. In modeling, the artist builds up his sculpture by adding layers of clay, wax, or some other soft, pliable material that will stick to, and blend with, itself.

Because the materials used in modeling are soft, brittle, or otherwise impermanent, most modeled sculpture is turned into a more lasting form. From the earliest times, sculptors have preserved clay figures by baking them until they are hard. Figures made in this way are called *terra cotta*, an Italian term meaning *cooked earth*. Usually, only small figures can be made by this process, and they break easily.

A common way to make a modeled sculpture permanent is to *cast* it in metal or another hard material. First, the artist makes a mold of the modeled work. Into the mold, he pours a more permanent material—cement, bronze, or aluminum, for example—and lets it harden. As long as the mold lasts, he can cast any number of replicas of the original. See CAST AND CASTING.

Sculptors today experiment with new industrial techniques and materials, and no longer create sculpture exclusively by carving or modeling.

The First Sculptors. Men of the Stone Age used sharp flint knives to carve wood and bone. On their spearheads they scratched pictures of animals. They also carved little figurines, including the so-called *Venus of Willendorf* (page 204).

Ancient Egyptian sculptors used only simple stone tools to skillfully cut and polish the hardest stones. To make a statue such as the one of *King Mycerinus of Egypt and his queen* (page 198), the sculptor chose a block of stone and trimmed it into a right-angled solid slightly larger than the finished work would be. On each side, he drew an outline of the figure to be carved. He copied the outline from a master drawing on papyrus.

Next, the sculptor removed the excess stone on the corners of the block by crushing it with a stone mallet or a pounding stone. The result was a blocklike figure that needed only to have the edges and corners rounded and details added. The artist rounded off the corners of the figure by slowly chipping away layers of stone. As each layer was removed, the sculptor's technique became more skillful. Finally, the sculptor rubbed and polished the figure until it had the hard, clean-cut look characteristic of Egyptian sculpture. This *finishing* treatment was done with special hard rubbing stones and a mixture of fine, glassy sand and water.

The Egyptians carved wooden figures in the same way, but wood could be carved more quickly because it is softer than stone. The sculptor gave the finished wood figure a thin coat of plaster or *bitumen* (a tarlike material). Then he painted the figure in bright colors and *gilded* it (coated it with a thin layer of gold).

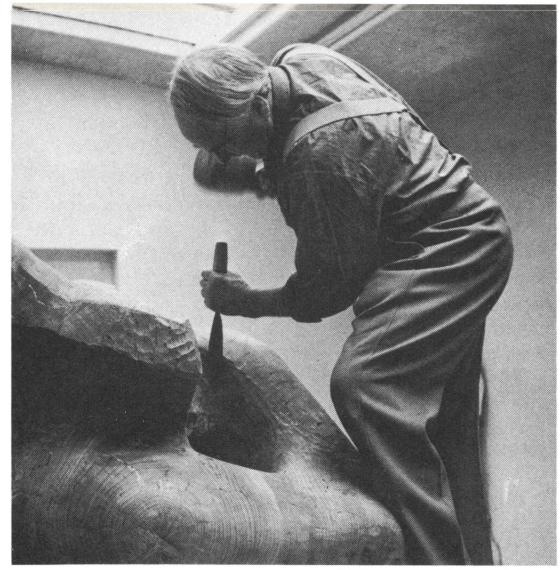


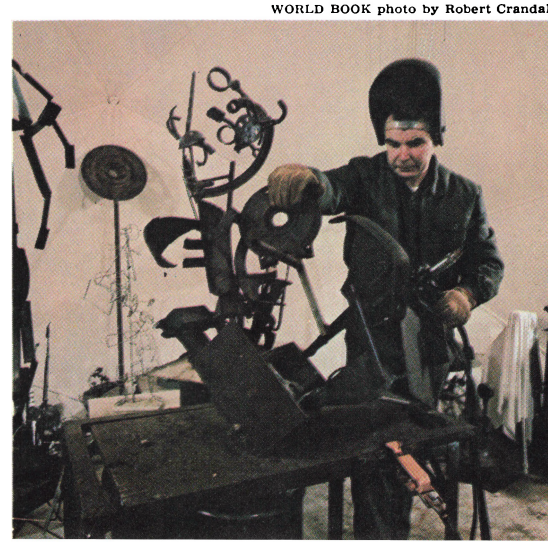
Photo courtesy of Henry Moore

Carving in Wood, the British sculptor Henry Moore uses a mallet and chisel to trim a block of elmwood to the desired shape. Modern carvers use the same kinds of tools as the ancient Greeks used.

WORLD BOOK photo by Erich Lessing, Magnum

Modeling in Clay, the Italian sculptor Giacomo Manzù builds up a figure with small pieces of clay. He then will make a permanent cast of the figure in bronze, similar to the one at his right.

WORLD BOOK photo by Robert Crandall



In the Direct-Metal Technique, the American sculptor Richard Stankiewicz uses a welding torch to join pieces of metal into a finished piece of sculpture.

Egyptian sculptors had workshops that were organized somewhat like the mass-production lines in factories today. Beginner-sculptors and apprentices did the rough work at the early stages of the carving. Skilled sculptors did the final carving, and specialists did the finishing work. The master sculptor probably became more of a studio manager and administrator than an artist as he reached the top of his profession.

The Egyptian method of carving was practiced throughout Mesopotamia, Assyria, and other parts of the ancient Middle East. Middle Eastern sculptors worked with jewelers to make beautiful metal sculpture by the *repoussé* process. First, the sculptor carved a wooden pattern. Then sheets of gold or silver were hammered into shape over the pattern. The shields, helmets, and cups made by this process are small-scale sculptures that made up part of the furnishings of a palace.

Greek Sculptors took their stone-working techniques from the Egyptians and from civilizations in Asia Minor. By the 500's B.C., the Greeks were carving most of their statues from white marble. They used hand tools made of hard bronze and iron. The sculptor set up a block of marble and drew an outline of the figure on it. Then he roughed out the figure with a hammer studded with sharp points. He used pointed chisels for the finer work. As the sculptor grew closer to the finished work, he used smaller tools and made lighter blows with his hammer. Finally, he gave a sharp edge to the figure's eyes and lips with a triangular, pointed tool. He used specially shaped tools to cut out folds in drapery, in the same way that *flutes* (grooves) were cut in architectural columns.

A royal group

An altarpiece of the Benin people. Nigeria, perhaps dating from the late A.D. 1700's. Bronze. 24 in. (61 cm) high.

Museum für Völkerkunde, Staatliche Museen, Berlin, from Art Reference Bureau

Museum of Fine Arts, Boston; WORLD BOOK photo by Robert Crandall

King Mycerinus of Egypt and his queen

Egypt (Dynasty IV), 2600-2500 B.C. Schist. 4 ft. 7 in. (1.40 m) high.

The Greeks also modeled many sculptures, ranging from small figures for the home to giant terra-cotta statues that decorated temples. Artists learned to *fire* (bake) the huge terra-cotta sculptures without having them break. They used this knowledge to cast life-sized or larger bronze figures of men and animals.

When casting a sculpture in bronze, the sculptor first modeled his work in wax. He dipped the wax figure in a *refractory mixture* (a kind of clay mixture), and then fired it. As the figure baked hard, the wax melted and drained out, leaving a hollow mold in the shape of the original figure. The sculptor then poured liquid bronze into the mold. This casting process is called *cire-perdue*, a French term meaning *lost-wax*.

Sculptors throughout the world have used the lost-wax casting process. The people of the ancient kingdom of Benin in Nigeria used this process to make such splendid bronzes as the *altarpiece* shown here.

Roman Sculptors. The finest work of Roman sculptors was probably their mass-produced portrait sculpture. The *portrait of Lucius Verus* is an example. To meet the large demand for portrait busts, the Romans developed a set of standard symbols for hair, eyes, nose, and mouth. A student learned to carve by reproducing these

details accurately, rather than by copying a living model. After learning to carve the standard symbols, he modified them to produce a likeness of a particular individual. Art schools used this method of teaching—in which sculpture itself is the model—until as recently as the 1940's. The method is still used in Russia.

Medieval and Renaissance Sculptors used the same methods and tools as did ancient sculptors. Medieval sculptors also used specially shaped tools for wood carving, which resulted in highly intricate work. These artists worked in organized workshops called *guilds*.

During the 1400's and 1500's, Renaissance sculptors cast such small-scale bronzes as *Hercules and Antaeus* by Antonio del Pollaiuolo of Italy. These sculptors rediscovered the techniques of large-scale bronze casting, and produced giant *equestrian monuments* (figures on horseback). Machines were developed to help enlarge the models. These machines led to the development of carving machines that copied and enlarged stone sculpture entirely mechanically. The carving machines were used for a short time during the 1700's and 1800's.

Sculptors of the 1800's, like Renaissance sculptors, worked in large workshops with student assistants. During this period, the industrially developed technique of sand-mold casting was used to mass-produce bronzes.

Sculptors Today. Social and economic changes in the 1900's have forced sculptors to use methods and materials different from those of the past. Most modern sculptors work alone, rather than in workshops. They are trained in schools, not in workshops as apprentices. They must produce works quickly because of the expense of maintaining a large studio and buying tools and materials. Sculptors also must show collections of their work at art galleries at regular intervals, both to sell their output and to attract commissions. Only occasionally are sculptors paid in advance, because few patrons request specific works to be sculptured.

Today, hardly any sculptors carve in wood or stone. Carving is strenuous and time-consuming, and is not finished until the artist makes the last stroke with mallet and chisel. In addition, the sculptor's money is tied up in heavy, expensive materials. Modeling is much faster and more flexible than carving. A modeler can add to or take away from the sculptured form, changing his design as he works. This sense of speed and urgency appeals to modern artists.

Museo Nazionale del Bargello, Florence, from Art Reference Bureau

Hercules and Antaeus by Antonio del Pollaiuolo
Italy, about 1475-1480. Bronze. 18 in. (46 cm) high.

A modeler uses soft materials including sculptor's wax, wet plaster, clay, or a synthetic clay called *plasticene*. His main tools are his hands, but he also uses different kinds of trimming and shaping tools. Soft clay and wet plaster fall down because of their own weight when they are drawn into thin shapes. The modeler overcomes this situation by building a framework called an *armature* to support the figure. An armature consists of wire for small figures, and metal tubing or wood for large figures. To give the sculpture permanence, a casting must be made. This is a highly specialized and expensive process that few sculptors are equipped to do themselves. Most of them make a *maquette* (model) and take it to a foundry where an enlarged copy is cast under the artist's supervision.

Because of the difficulties in casting, many sculptors work metal by hand. With such modern industrial equipment as electric arc and gas welding tools, an artist can cut and shape metal and then join it together again. Using this *direct-metal* technique, sculptors build works out of wire, pipe, sheet metal, and even junk metal from wrecked automobiles.

Other modern sculptors choose ready-made materials and assemble them into sculpture. They use a variety of materials, including steel girders, bolts, gear wheels, cardboard, and cloth. The tools used in this *assemblage* technique include power saws, drills, and hammers.

To finish their sculptures, modern artists use such industrial equipment as sandblasting machines and grinding tools driven by power motors. They can produce a *patina* (surface film) on bronze by applying heat and various chemicals to the finished work. This treatment changes the natural shine and golden color of bronze to reddish-brown, green, or black.

Portrait of Lucius Verus
Rome, A.D. 100's. Marble.
Approximately life size.

Ashmolean Museum, Oxford, from Art Reference Bureau

Charioteer of Delphi
Greece, about 475 B.C. Bronze. 5 ft. 11 in. (1.80 m) high.

Delphi Museum, Delphi, Greece; photo by Raymond V. Schoder, S.J.

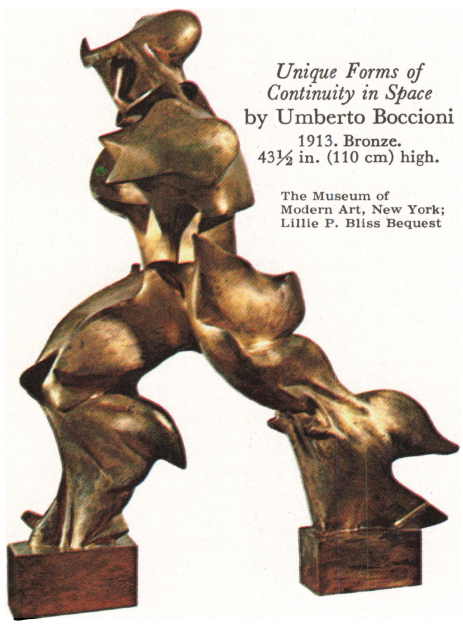
SCULPTURE / *Sculpture as an Art Form*

Kinds of Sculpture. The most familiar kind of sculpture is called *sculpture in the round* or *free-standing sculpture*. It is modeled or carved on all sides. Such sculpture can have a main view, giving it a "back" and a "front," as in certain sculptures of the human figure. Or it can be completely finished on all sides so that it can be viewed with pleasure from any angle, as can much abstract sculpture. In the past, some sculpture in the round was meant to be seen only from the front. The artist left the back of the figure rough and unpolished, with his tool marks showing. This practice has provided much information about the methods of sculptors of the past.

Sculpture in the round varies greatly in size and scale. Some statues are life size or larger. Statues that are somewhat larger than life size are said to be in *heroic* scale. If they are from several to many times larger than life size, they are in *colossal* scale.

Sculpture that is completely attached to, or absolutely part of, a flat surface is called *sculpture in relief*. There are two kinds of relief work—*true relief* and *intaglio*. In true relief, the figure stands out from the surface, as in *Lion Fighting a Bull* (page 205). In intaglio, the figure is carved into the background, as in the *seal carved with the figure of a unicorn* (page 206). The same technique was highly developed by the ancient Egyptians for decorating the massive outside walls of their temples. As used by the Egyptians, it is usually called *sunk relief*. This kind of relief is best seen in strong light, which makes the outlines of the figures stand out as sharp shadows. *Egyptian Soldiers Leading Prisoners* is an example (page 195).

Relief sculpture can be carved or modeled. Some of the early carved reliefs of the Egyptians are little



Unique Forms of Continuity in Space
by Umberto Boccioni
1913. Bronze.
43½ in. (110 cm) high.

The Museum of Modern Art, New York; Lillie P. Bliss Bequest

Red Petals by Alexander Calder
1942. Painted metal and wire. 8½ ft. (2.59 m) high.

The Arts Club of Chicago; WORLD BOOK photo

more than engraved lines on stone. Many Greek reliefs are shallow, but they stand up from a flat surface in true relief. In some reliefs, the Greeks flattened off the forms nearest the viewer, and deeply undercut and rounded the forms at the back. Later Greek and Roman reliefs tend to have the nearer forms rounded, as in painting. The figures seem almost detached from the background, as in the *Alexander Sarcophagus* (page 206e).

Reliefs can also be modeled in clay or wax and cast in bronze. Two famous examples of cast reliefs are the doors for the Florentine Baptistry by the Italian Renaissance sculptor Lorenzo Ghiberti, and the new doors for Saint Peter's Basilica in Rome by the modern Italian sculptor Giacomo Manzù. See ITALY (color picture: Modern Italian Sculpture).

Form and Treatment. Sculptors use many elements found in painting. These elements include space, mass, volume, line, movement, light and shadow, texture, and color. But a painting has only two dimensions—height and width—because it is created on a flat surface. The painter can give only an illusion of depth. By contrast, sculptured forms have three dimensions. They have depth, or solidity, as well as height and width because the sculptor creates his forms in space. The terms *mass* and *volume* are used to describe the way sculptured forms occupy space. Mass describes the amount of bulk, solidity, or weight of a form in space. Volume refers to the amount of space occupied by a sculpture. *Line*, or the edges of a sculpture, encloses or defines the shape of the sculptured form.

Movement is one of the most important elements of sculpture. Some sculptures seem to be completely at rest, and suggest little or no movement. For example, the bronze statue of the *Charioteer of Delphi* has a simple outline and little detail. It appears powerful, solid, and calm. It stands firmly on its base, in complete balance. This kind of sculpture is called *static*.

Sculpture that gives an impression of change, movement, and energy is called *dynamic*. Sculptors can create the illusion of movement in several ways. In *Unique Forms of Continuity in Space*, the modern Italian sculptor Umberto Boccioni created rhythms within the statue itself through the repetition of curved shapes. The figure seems to hurl itself through space in successive stages of continuing movement. Antoine Coysevox, a French sculptor, showed a figure in violent action in his statue of *Mercury* (page 206k). When we look at such a figure, our eyes follow the lines of the body and the limbs. These lines lead in many directions in such an arrangement, creating a feeling of movement.

Some sculptures actually do move. These works are called *kinetic* sculpture. The first and most original kinetic sculptures were the *mobiles* invented by the modern American sculptor Alexander Calder. As in *Red Petals*, the various elements of most of Calder's mobiles are made of thin sheet metal. Some of them suggest swimming fish or leaves blowing on a tree. The metal shapes are linked by rods and wires to form a series of balanced pairs which are suspended from one point. They rotate about each other in the lightest breeze.

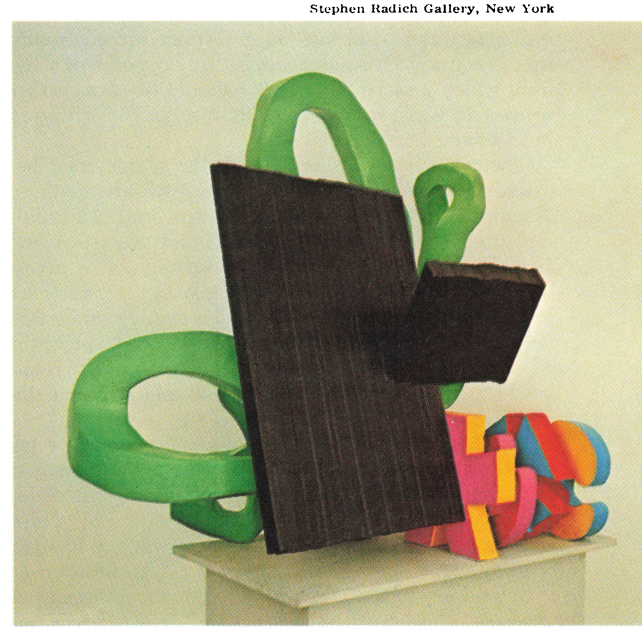
Some artists build kinetic sculptures in which the various parts move mechanically. The modern French sculptor Jean Tinguely makes elaborately complicated structures out of scrap metal. They have mechanically moving parts which actually break apart, turning the sculpture into scrap once more. The sculpture's "self-destruction" is part of the artist's purpose.

Light and Shadow. A painter shows form by using light and dark shades. After this shading is finished, it is unchangeable. A sculptor builds form, and the shading varies with the light that falls on it. In his imagination or in his preparatory drawings, the artist must consider the effect of light and shadow on his forms.

Texture. Because of the natural play of light and shadow, the sculptor also must consider the texture of his forms. He must decide whether to leave the surface of his work rough, or how far to go in giving it a smooth, highly polished surface. A rough surface, such as one showing the sculptor's hand marks or tool marks, catches light and gives the sculpture an appearance of dash and liveliness. A smooth, highly polished surface can make a work as impersonal as a piece of machinery.

Color. Many sculptors finish their works with color. Colors are naturally lighter and darker in themselves. For example, pure blue tends to be dark, red has a middle tone, and yellow tends to be light. As a result, when the sculptor colors his work, he interferes with the natural process of shading. This matters little to some sculptors. Egyptian and Greek sculptors attempted to color their statues naturalistically by painting the skin, lips, eyes, and hair. However, the colors have faded from most of their works that still survive. Many modern sculptors combine color and sculptural form, as in *Black X* by the American George Sugarman. But such works look like modern painting done in three dimensions.

Black X by George Sugarman
1963-1964. Multicolored, laminated wood. 4 ft. 2½ in. (1.28 m) high.
Stephen Radich Gallery, New York



LOOKING AT SCULPTURE

by Sir Herbert Read

The first quality to appreciate in sculpture is its volume or mass—the fact that it is three-dimensional. Relief sculpture gives the illusion of objects occupying space, but sculpture as a distinct art is usually in the round. Thus, there is no single point of view from which a piece of sculpture should be seen. Either we should walk around the sculpture, or the sculpture itself should be rotated.

There are many exceptions to the above rule, because of the association of sculpture with architecture. If sculpture is to be incorporated in the front of a building, it can be seen only from a frontal point of view. In this case, most sculptors have not thought it necessary to carve the back of the figure with the same care as the front of the figure. But if a figure stands free and is not necessarily intended to take its place in a particular architectural setting, the artist must visualize his sculpture in the round, and make it equally effective from every point of view.

Before the Renaissance, monumental sculpture (as distinct from small sculpture) was planned and created in association with architecture. In the ancient civilizations of the Middle East and India, almost all sculpture was a basic part of a building. If Greek and Roman sculpture was not actually carved for a position on or in a temple, most of it was part of an architectural scheme—a forum, a palace, a villa, or a tomb. Even most Roman portrait busts were set in a *niche* (hollow in a wall), which itself might be carved. The sculpture of the Gothic period—except for small, portable objects—was planned as part of a building, or of an altar or a pulpit.

When Michelangelo carved his statue of David in the early 1500's, he had no particular site in mind for the work. A committee of artists was appointed to select a site in Florence. The committee decided that the statue was meant to be seen from the front and must be related to a wall surface. This debate made artists and their public aware for the first time of the problem of three-dimensionality in sculpture.

Benvenuto Cellini, who lived at the same time as Michelangelo, was perhaps the first sculptor to think about the free placement of sculpture in space. Cellini claimed that sculpture is seven times as great as any other art because a statue has 8, or even 40, viewpoints, all of which must be reconciled in a single overall unity.

After sculpture became independent of architecture, it grew into a unique art in itself. To fully appreciate the qualities of sculpture, we must develop a special kind of awareness. This awareness enables a person to respond to mass and volume, rather than to the qualities we associate with painting. The art of painting is associated almost exclusively with visual perception,

Warrior on a high-stepping horse (in the style of Leonardo da Vinci). Italy, about 1508. Bronze. Figures about 9½ in. (24 cm) high. Szépművészeti Múzeum, Budapest; WORLD BOOK photo by Erich Lessing, Magnum

We enjoy sculpture most when we can move around it, seeing all sides of the work as the sculptor meant it to be seen. The twisting, spiraling forms of this horse and rider come to life only when we look at the statue from every side.

and involves qualities of linear rhythm, color harmony, and *perspective* (the illusion of deep space). The art of sculpture is associated with *tactile* sensations (sensations of touch), and with those hard-to-define sensations associated with weight and pressure. We should touch and handle a sculpture to sense its three-dimensional shape, as well as its texture. We should also lift, or imagine ourselves lifting, the object to sense its weight.

Great modern sculptors, including Auguste Rodin and Henry Moore, have emphasized the importance of feelings of thrust and pressure. Their works provide these feelings by means of *bosses* (bulges) and hollows. Moore's *Reclining Figure* should be thought of as a tightly packed volume held in tension by the pressure of the surrounding atmosphere. We need some practice or experience to develop this specific approach to sculpture. But when such an approach has been perfected, we can derive greater pleasure from sculpture than from painting.

Today, there is a tendency to abandon the established tradition of sculpture, and to construct objects of steel, iron, concrete, plastics, and other materials that appeal more to the visual senses. Modern sculptors skillfully use their materials to create linear and dynamic effects, as Alexander Calder did in *Red Petals* (page 200). The spectator has no desire to handle these objects, many of which are prickly, and their weight is not important. Most of them are abstract in style. Like architecture, these modern sculptures define or enclose space rather than occupy it.

Sculpture began as architecture. Today, it seems to be returning to its original nature and function.

Reclining Figure by Henry Moore
1935. Elmwood. 35 in. (89 cm) long.
Albright-Knox Art Gallery, Buffalo, N.Y.

Prehistoric Sculpture. Men of the Stone Age thought they recognized the forms of living things in such objects as bones, animal horns, and rocks. Prehistoric sculptors carved eyes or arms and legs in these objects to make them look like men or animals.

There were only a few subjects of prehistoric sculpture, and all of them apparently had some magic significance. The figure of *a bison licking itself* and other animal figures probably represented animals killed by hunters. Figures of a plump woman, such as the *Venus of Willendorf*, may have represented the Mother Goddess, who gave life to man and his food.

After prehistoric peoples learned to make pottery vessels by firing clay, they used this technique to make figurines. Terra-cotta figurines have been found in many parts of Egypt, Asia Minor, Mesopotamia, and the Indus Valley. Although few details appear on these figurines, the sculptors obviously did try to emphasize such important physical features as an animal's strong horns or neck, or a goddess's breasts and buttocks.

Beginning about 3000 B.C., ancient civilizations produced many fine sculptures. By this time, artists had gained skill at working with such harder materials as stone and metals.

Middle Eastern. Most early Mesopotamian sculpture consists of small-scale figures of kings or priests. For example, the *stele of Ur-Nammu* shows Ur-Nammu, king of the Sumerian city-state Ur, pouring a *libation* (offering) to the goddess Ningal. Mesopotamian sculptors showed their subjects in stiff poses, and did not attempt to suggest movement or to portray actual persons. Livelier scenes of everyday life appear only on minor stone reliefs that decorated furniture or boxes.

During the era of the Assyrian Empire (900's B.C. to 600's B.C.), sculpture was used mainly as architectural decoration. The Assyrians carved colossal stone figures of bulls with human heads to stand beside palace gateways. Palace walls were decorated with reliefs made

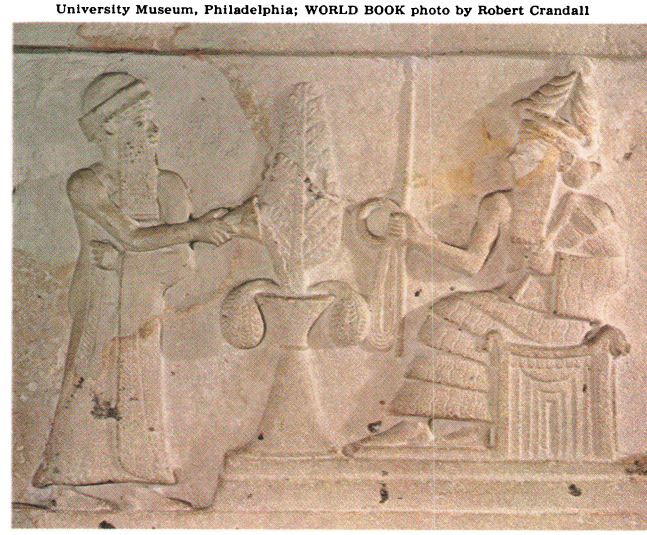
Venus of Willendorf
Willendorf, Austria,
30,000-25,000 B.C.
Limestone. 4⅜ in. (11 cm) high.

Naturhistorischen Museum,
Vienna, Austria

Musée des Antiquités Nationales,
St.-Germain-en-Laye, France, from Art Reference Bureau

A bison licking itself
From the cave of La Madeleine in the Dordogne Valley, France, about 9000 B.C. Reindeer antler. About 4 in. (10 cm) high.

University Museum, Philadelphia; WORLD BOOK photo by Robert Crandall



Stele of Ur-Nammu (detail)
Relief showing Ur-Nammu, king of the Sumerian city-state Ur, pouring a libation before the goddess Ningal.
Mesopotamia, about 2054-1946 B.C. Limestone.
Figure of king about 15 in. (38 cm) high.

Leon Harmon, Photo Researchers

Lion Fighting a Bull

Relief from the stairway to the Audience Hall of Darius I at Persepolis. Persia (Achaemenid Empire), about 500 B.C. Stone. Figures over life size.

up of many scenes. These scenes told the story of complete military campaigns and other important events. Some of the finest relief carvings are those from Nineveh (now Kuyunjik), showing a royal lion hunt. Assyrian sculptors carved the forms and movements of animals more accurately and realistically than earlier sculptors did. But their human figures were stiff and unemotional, both in relief carvings and in the few large figures that they carved in the round.

Persian sculptors of the Achaemenid Empire (500's B.C. to 300's B.C.) also were interested in the patterns of animal limbs and muscles. An example of their work is the relief *Lion Fighting a Bull*. The Persians decorated buildings with large relief sculpture, but their finest work was on a small scale. Some of it shows clear signs of influence from classical Greece.

The Hittites, who founded a great kingdom in Asia Minor after 2000 B.C., used architectural relief sculpture in a manner similar to the Assyrians. They also carved a number of large monuments from solid rock, showing kings, gods, or religious ceremonies.

Aegean. The islanders who inhabited the Cyclades in the Aegean Sea about 3000 B.C. carved figures in white marble. Like the *Cycladic Marble Figurine*, most of these figures were of women. The sculptors had no metal tools, but rubbed the figures smooth with pebbles of emery.

During the 1500's and 1400's B.C., the Minoans of Crete made superb small figures of worshipers, cast solid in bronze. They did not smooth or polish the bronze, so these figures have a rough finish. The figures show a vigor not developed elsewhere at this early date, as can be seen in the bronze figure of a *woman praying*.

The Mycenaean Greeks copied the Minoans, but with little success. Their best attempt is the relief over the Lion Gate at Mycenae.

Egyptian. A distinctive style of sculpture developed in Egypt about 3000 B.C., and continued with little major change for more than 3000 years. Egyptian sculpture was made for limited purposes—to commemorate a person or event, or to serve as a substitute for the activities of real persons.

Ashmolean Museum, Oxford, from Art Reference Bureau

Cycladic Marble Figurine

Cyclades Islands, Greece, about 3000 B.C. Marble. 30 in. (76 cm) high.

Staatliche Museen, Berlin, from Art Reference Bureau

Woman Praying

Crete, Minoan period, 1500's B.C. Bronze. 7½ in. (19 cm) high.

Commemorative sculpture includes *King Mycerinus of Egypt and his queen* (page 198) and other great statues of kings and queens, whom the Egyptians regarded as gods. Some of these statues are colossal in scale. The seated statues of Ramses II, cut in rock at Abu Simbel, are more than 65 feet (20 meters) high. Reliefs covering the walls of temples commemorated religious ceremonies or such events as important battles. An excellent example of a battle relief is *Egyptian Soldiers Leading Prisoners* (page 195).

Egyptian sculptors also carved stone or wooden statues which were placed in tombs to represent the dead. These reliefs and modeled figures showed scenes of daily life similar to the activities the dead were expected to perform in the next world.

In carving the human figure, the Egyptians considered realistic scale unimportant. They showed a king much taller than his subjects or his enemies. Egyptian sculptors followed fixed rules that controlled the proportions of the parts of the body. These rules applied to sculptures ranging from tiny figures to colossal statues carved out of cliffs.

Tradition also required figures to have quiet, restful poses and expressionless faces. The Egyptians considered any vigorous action or realism unnecessary. Only for a short time during the 1300's B.C. did some realism appear in figures and portraits.

Indus Valley. The Indus Valley civilization flourished in what is now Pakistan and western India from about 2500 B.C. to about 1700 B.C. Sculptures have survived from the major areas of this civilization, including such centers as Mohenjo-daro, Harappa, Lothal, Rupar, and Maheshwar. These sculptures include small stone tablets that were used as seals, and figures of animals and human beings that apparently were used in magic ceremonies.

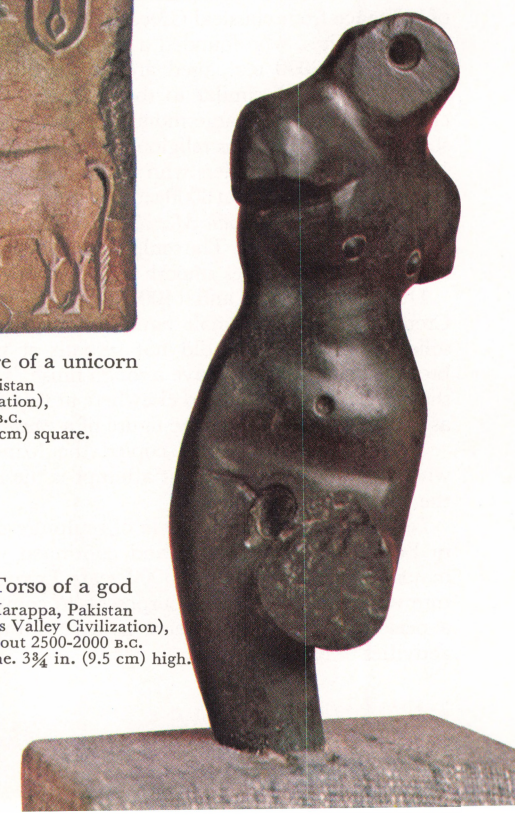
The seals show the rounded forms of bulls, elephants, and rhinoceroses, along with triangular, curved, and vertical signs. Such seals as the *seal carved with the figure of a unicorn* show the ability of the Indus people to carve intaglio in delicate, curved lines.

The limestone *torso of a god* is believed to represent a friendly god. The rhythmic repetition of the curving lines of the torso shows a love of linear rhythm. Indus sculptors also stressed harmonized forms, as shown in the way the torso is unified by the softly swelling curves of the body. The sculptor has carefully rounded these curves, especially the abdomen. This emphasis on harmonized forms appeared later as a dominant characteristic of Indian sculpture.

Linear rhythm is also apparent in the bronze *statuette of a dancer*. The sculptor has captured the dancer at the moment when she is either pausing after a movement or is just about to move. The dynamic quality of this sleek figure is partly due to the rhythmic, angular thrusts of her arms, legs, and torso. The sculptor has also indicated movement by contrasting the linear rhythms of the torso and legs against the triangular right arm and the forward left leg. This contrast of linear rhythm with square and triangular shapes to produce movement characterized later Indian sculpture, both Buddhist and Hindu.

Statuette of a dancer
Mohenjo-daro, Pakistan
(Indus Valley, Civilization),
about 2500-2000 B.C.
Bronze. About 4 in.
(10 cm) high.

Seal carved with the figure of a unicorn
Mohenjo-daro, Pakistan
(Indus Valley Civilization),
about 2500-2000 B.C.
Soapstone. About 2 in. (5 cm) square.



Torso of a god
Harappa, Pakistan
(Indus Valley Civilization),
about 2500-2000 B.C.
Limestone. 3¾ in. (9.5 cm) high.

National Museum, New Delhi;
WORLD BOOK photos
by Dhiraj Chawda

India. During the first thousand years of Indian culture, from the 500's B.C. to the A.D. 500's, Indian sculpture shows the influence of the Buddhist religion. Some of the most magnificent Buddhist sculptures decorate the gateways and stone railings that surround *stupas* (domed mounds). These mounds were built to enshrine the relics of the Buddha. The sculptures are relief carvings that illustrate the life and teachings of the Buddha. The delicate carvings that decorate stupas at Amraoti, Barhut, and Sanchi seem to contain the energy of life. In the *fragment of a relief from the stupa at Amraoti*, the dense composition of the scenes, with many elements in a small space, shows the skill of Indian relief carvers. These craftsmen were originally trained in ivory carving.

The earliest reliefs were merely lines engraved on a flat surface. They had no depth. After about A.D. 1, Indian sculptors were influenced by the art of the Roman Empire. They produced deeper and more rounded reliefs. Many Indian reliefs are so deeply carved that they give the effect of free-standing sculpture.

The art of medieval India, dating from the A.D. 500's, reflects the influence of Hinduism. Shiva, the Hindu god of destruction, is portrayed in many sculptures. A number of sculptures show Shiva as Nataraja, Lord of the Dance. Most of them portray him as a figure with four arms, trampling the body of a dwarf representing evil. In some sculptures, a ring of fire, representing the universe, surrounds the figure of the dancing Shiva.

The bronze image of *The Hindu god Shiva as Nataraja, Lord of the Dance*, shows linear rhythms in their purest form. Indian sculptors were highly skilled in the lost-wax method of casting, as shown in the perfect balance of Shiva, poised at the height of his dance. Sculptors of India used the lost-wax method of casting from the early medieval period on, especially in the southern peninsula.

China. The early Chinese, like other ancient peoples, faced the mysteries of the universe by making offerings to unknown spirits. The earliest Chinese sculptures were small figures that were placed in tombs. These tomb sculptures date from sometime before the Shang dynasty (about 1500 B.C. to 1027 B.C.). They were of exquisite workmanship.

From the Shang dynasty through the Han dynasty (202 B.C. to A.D. 220), craftsmen made bronze bells and other metal objects along with ceramic and jade works. All these were used for ancestor worship. The production of such sculptures led to the foundation of guilds of highly skilled craftsmen who produced masterly sculptural works.

Early sculptors bored holes in rounded objects to suggest space relationships. These artists scooped hollows from forms so that light could play over the uneven surfaces, thus creating the effect of energy and movement.

During the Han dynasty, the influence of Buddhist art traveled from India across central Asia to China by way of the silk trade routes. Chinese sculptors began to carve monumental wood and stone figures of the Buddha. Their patient skill and love of finish transformed the foreign Indian tradition into graceful

Government Museum, Madras, India; WORLD BOOK photo by Dhiraj Chawda

Fragment of a relief from the stupa at Amraoti

This fragment shows the entire stupa, a domed mound that enshrined the relics of the Buddha. India, about A.D. 200. Stone. About 6 ft. 3 in. (1.90 m) high.

The Hindu god Shiva as Nataraja, Lord of the Dance

Southern India, A.D. 1100's. Bronze. 5 ft. ½ in. (1.54 m) high.

Rijksmuseum, Amsterdam, from Art Reference Bureau

Museum of Fine Arts, Boston, Francis Bartlett Donation of 1912; WORLD BOOK photo by Robert Crandall

rhythms. The unique grace which the Chinese gave to the Buddha's face is shown in the wood carving of the *Head of Buddha*. The suggestion of a mysterious smile gives this work complete tranquillity.

A favorite subject in Oriental sculpture has been the *bodhisattva*, a person potentially capable of becoming a Buddha. In handling the form of the bodhisattva, the Chinese improved upon the rather severe Indian sculptures of the same subject. Chinese sculptors introduced such decorative elements as ropes of pearls, jewelry, and falling scarfs, which added something new to the Asian tradition of carving. These decorative objects can be seen in the figure of *Kuan Yin, goddess of mercy in Chinese Buddhism*, who is called *Bodhisattva Avalokitesvara* in India. The slightly bent posture of the figure reflects the tenderness that Chinese Buddhism introduced into the Indian interpretation of the Buddha's teachings.

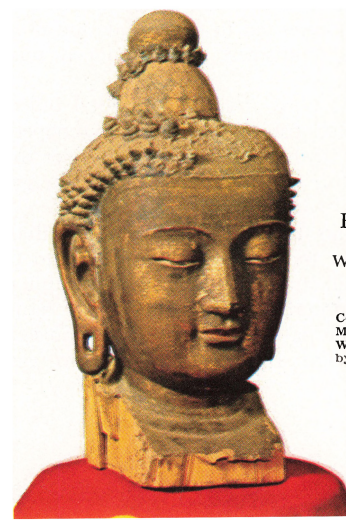
Chinese sculptors also made decorative, nonreligious sculpture in ceramic and jade. Their emphasis on pure line and volume and on polished finish of fundamental forms continued until the A.D. 1700's.

Ceylon and Southeast Asia. Beginning in the 200's B.C., traders and missionaries carried Indian cultural influences to the nations of the Indian Ocean. These countries included Ceylon (now Sri Lanka), Burma, Thailand, Cambodia, Malaya, Java, and Sumatra. The influence of Indian culture increased after the Christian era began, especially during periods of rule by monarchs of Indian origin.

The peoples of Ceylon and southeast Asia combined their own forceful, primitive beliefs with the soul-centered doctrines of India. As Chinese culture gradually reached these countries, it added another aspect to the contemplation of life and death.

The relief carvings of Angkor Wat and other Hindu temples of Cambodia are of greater size and scale than anything achieved in India. The temple of Borobudur in central Java is one of the three greatest Buddhist monuments in the world. The ruins of the ancient cities of Anuradhapura and Polonnaruwa in northern Sri Lanka include temples, palaces, monasteries, and stupas that surpass in artistic achievement many similar structures in India.

Kuan Yin, goddess of mercy in Chinese Buddhism
China, about A.D. 580. Painted stone. 8 ft. 2 in. (2.49 m) high.



Head of Buddha
China, A.D. 600's. Wood. 20 in. (51 cm) high.

Collection of Mulk Raj Anand, New Delhi; WORLD BOOK photo by Dhiraj Chawda

The seated *Buddha of Anuradhapura* illustrates the portrayal of the perfect yogi. The Buddha radiates both stillness and motion. Sculptors tried to make thought itself liquid and flowing, as in the great Indian tradition of carving. The emphasis of sculpture throughout Sri Lanka and southeast Asia, as in India, is on swelling, rounded forms, linear rhythm, and the search for balance in space.

Japan. The prehistoric peoples of Japan made clay figures intended as funeral sculptures. The figures derive their power from early man's love of monumentality. In this respect, Japanese figures resemble similar works of other Oriental civilizations, especially those of China.

During the medieval period, beginning in the A.D. 600's, Japanese sculptors absorbed the power and intensity of the prehistoric clay figures, and gave a certain resilience to the art of carving. The dramatic aspect of *Aizen Myo-o, god of love in Japanese Buddhism*, is the result of the Japanese talent for portraying psychological moods through the facial expressions and bodily attitudes of sculptured figures.

Japanese sculptors have always been able to absorb foreign techniques. Medieval sculptors took from China a love of rounded forms. The lyrical, cylindrical forms of Korean Buddhist figures also influenced Japanese handling of forms.

The Japanese preferred wood carving with gold coloring, similar to that of the Sui, T'ang, and Sung periods in China. They excelled in simplification of structure and in abstraction of detail to stress severely simple lines.

WORLD BOOK photo by Dhiraj Chawda

Seated Buddha from Anuradhapura
Ceylon, A.D. 500's. Stone. Over life size.

Aizen Myo-o, god of love in Japanese Buddhism
Japan, about A.D. 1300. Painted wood. 36 in. (91 cm) high.

Museum of Fine Arts, Boston; Gift of F. G. Curtis; WORLD BOOK photo by Robert Crandall

Kore 675

Greece (island of Chios), about 520 B.C. Marble. 22 in. (56 cm) high.

Acropolis Museum, Athens; photo by Raymond V. Schoder, S.J.

Early Greek sculptors made simple, formal works. They gradually learned to make realistic figures and to indicate emotion by facial expression or bodily pose. This was the style copied by Roman sculptors and relearned by Renaissance sculptors. It served as the basic style for European sculpture until the late 1800's.

There were three major periods in the development of Greek art. The Archaic period dated from about 630 to about 480 B.C. The Classical period lasted until about 323 B.C. The Hellenistic period ended about 146 B.C.

Archaic Sculpture. In the 700's B.C., before the Archaic period, artists knew how to make only small figures of clay or bronze. However, they also may have carved wooden statues. During the 600's B.C., they began making clay figures in molds. The Greeks learned this technique from the Phoenicians and other peoples of the East. Archaic sculptors developed a rigid and Eastern-looking style called *Dedalic*, which they also used in carving small limestone figures.

At the end of the 600's B.C., the Greeks learned from the Egyptians how to make larger statues, and how to carve harder stone—their own white marble. From then until about 480 B.C., the Greeks perfected their carving techniques and gradually succeeded in making figures that were more lifelike. They carved many standing figures of naked male youths. These figures, called *kouroi*, served as attendants to the temple of a god, or as memorials over tombs. Similar carvings of clothed maidens were called *korai*. The frontal pose and calm expression of *Kore* shows how much the Greeks improved on Egyptian work. Livelier figures appeared in reliefs on temples and treasuries, as in the *Battle of the Gods and Giants* from the Treasury of the Siphnians at Delphi.

Classical Sculpture. After Greek sculptors learned to show the human body accurately, they paid more attention to drapery. In early classical works, drapery hung straight and rather stiffly, as in the *Charioteer of Delphi* (page 200). In later works, it hung in deeply

Battle of the Gods and Giants

Detail from the north frieze of the Treasury of the Siphnians at Delphi. Greece, about 525 B.C. Marble. 26 in. (66 cm) high.

Delphi Museum, Delphi, Greece; photo by Raymond V. Schoder, S.J.

Archaeological Museum, Istanbul, Turkey; Hirmer Foto from Art Reference Bureau

The Alexander Sarcophagus (detail)
Relief showing Alexander the Great hunting lions, from a coffin made for a ruler of Sidon. Phoenicia, about 323 B.C. Painted marble. Frieze 23 in. (58 cm) high.

cut folds. Finally, sculptors showed drapery clinging to the body or blowing free from it.

The Greeks thought of their gods as being like men, and sculptors portrayed gods as men in such works as the *Greek god Poseidon* or *Zeus* (page 192). They showed men as godlike beings. Even after sculptors began to make portraits of real persons, they idealized the faces.

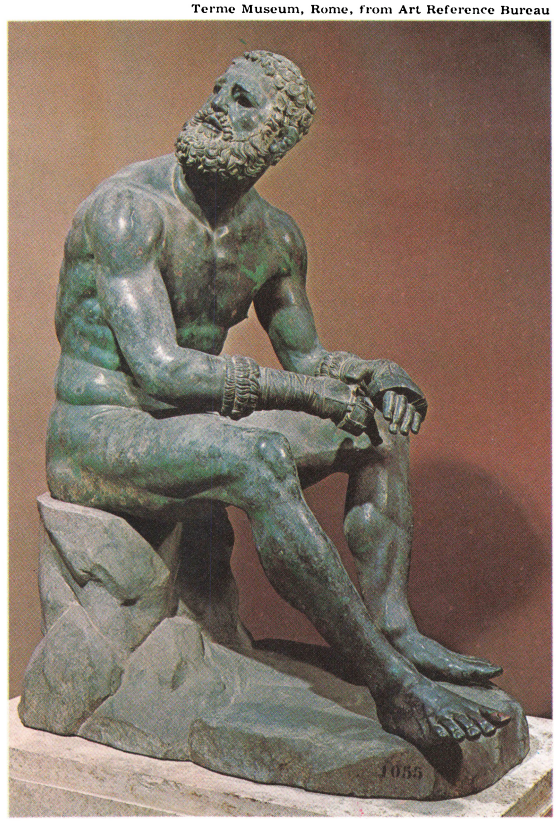
The earliest important classical sculpture appeared on the Temple of Zeus at Olympia. The high point of the classical style is generally considered to be the sculptures on the Parthenon in Athens. They were created after the mid-400's B.C.

During the 300's B.C., sculptures of the human figure showed some emotion and vigorous action. Some sculptors showed goddesses nude for the first time. Lysippus made heavily built athlete figures. Praxiteles specialized in a softer, flowing style in his figures of gods and goddesses. Sculptors decorated *sarcophagi* (stone coffins) with reliefs, as in the *Alexander Sarcophagus*. Portrait sculpture also began during this period.

Hellenistic Sculpture. The conquests of Alexander the Great carried Greek culture into Egypt and the lands of the East. After Alexander's death in 323 B.C., his empire was split into smaller kingdoms. In these kingdoms, the courts encouraged local schools of art, the most important of which were at Rhodes, Pergamum, and Alexandria. Artists blended local ideas with Greek standards of beauty. The result was a varied and colorful art called *Hellenistic*.

Athenian artists continued to follow a more classical style, but Hellenistic sculptors preferred to create works in active, dramatic poses. In such works as the *Laocoön* and the *Winged Victory of Samothrace*, sculptors portrayed violent feelings and lifelike actions. (For pictures of these famous sculptures, see the articles LAOCOÖN; and EUROPE [picture: Masterpieces of Art]). Many Hellenistic figures were much less idealized than were earlier works. In the *statue of a seated boxer*, for example, the sculptor showed a boxer's broken nose.

Statue of a seated boxer
Greece, about 100-70 B.C. Bronze. About 4 ft. 2 in. (1.27 m) high.
Terme Museum, Rome, from Art Reference Bureau



Etruscan Sculpture. The Etruscans probably came from Asia Minor, and settled in Etruria (present-day Tuscany) in central Italy about 1000 B.C. They learned sculpture from Greek artists who settled in Etruria, and from Greeks living in neighboring colonies in southern Italy and Sicily.

The Etruscans specialized in bronzes and in terra-cotta works which they painted in bright colors. The best examples of their terra-cotta sculptures are the reclining figures on the lids of coffins, and the figure of *Apollo* and three other life-sized statues from the roof of a temple at Veii. Sculptures of this size are seldom achieved in clay, even today.

Etruscan sculptors also carved works from a soft limestone called *tufa*. These works included animals that were used to guard tombs, and reliefs that decorated boxes containing the ashes of the dead. The Etruscans showed a fondness for gruesome figures and for portraiture, particularly of ancestors. However, Etruscan artists gradually adopted classical Greek styles.

Roman Sculpture. The earliest Roman sculpture was influenced by the Etruscans to the north of Rome and by Greek colonists to the south. When the Romans conquered Greece and the Hellenistic kingdoms in the 100's B.C., they brought hundreds of Greek statues to Italy. They also encouraged Greek artists to work for Roman patrons.

These Greek artists brought to Italy the fully developed Hellenistic style, especially that of Alexandria. From 100 B.C. to A.D. 100, they produced many works in a Greek style which at the same time expressed Roman ideas.

Portraiture was important in Roman sculpture. Such portraits as the *portrait of Lucius Verus* on page 199 were more realistic than Greek examples, because Greek sculptors still idealized facial features to some degree. Roman sculptors often combined a Roman portrait head with a copy of a Greek statue of a god. They copied and changed famous Greek statues freely at all scales.

The Romans were deeply religious, and many reliefs from altars show ceremonies or symbolic stories. A famous example is the Ara Pacis (Altar of Peace) in Rome.

The Romans also were particularly interested in showing historical events, a theme which the Greeks had avoided. Reliefs on commemorative arches and columns tell the story of complete military campaigns. The best known columns are *Trajan's Column* and the Column of Marcus Aurelius.

Relief decoration on coffins was more Greek than Roman in style and subject matter. But many reliefs symbolized Roman and, later, Christian ideas about death. As time passed, later artists failed to further develop the basically Greek sculptural styles. Nor were these styles replaced by a stronger sculptural tradition.

Apollo

One of four figures from the roof of an Etruscan temple at Veii. Italy, about 500 B.C. Painted terra cotta. 5 ft. 8 in. (1.73 m) high.

Villa Giulia Museum, Rome; photo by Raymond V. Schoder, S.J.

Trajan's Column (detail)

Relief showing Trajan's campaign against the Dacians. Rome, A.D. 113. Marble. Relief band about 4 ft. 2 in. (1.27 m) high.

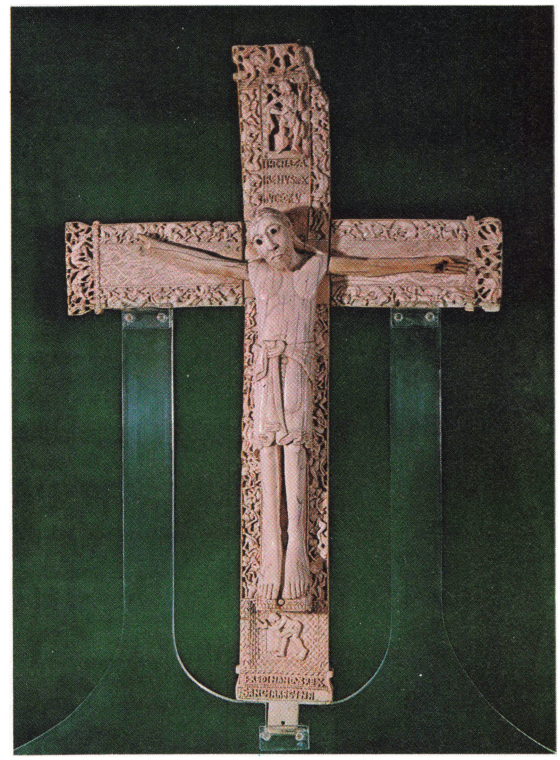
Near Trajan's Forum, Rome; WORLD BOOK photo by Leonard von Matt

As the Roman Empire declined, monumental sculpture died out almost completely, but the art still persisted in small ivories. In the Byzantine Empire, centered in Constantinople, sculptors developed a stiff, formal style. An artistic tradition was maintained in the courts of the Carolingian and Ottonian emperors in western Europe, as well as in monastery workshops.

Most of these sculptures show active scenes full of figures inspired by late Roman sculpture. In Britain, the Celts and Saxons combined their traditional art forms with Christian subjects. They used a complicated ornamental style of interlaced bands, or of birds and beasts entwined in vine scrolls. They combined this style with crude but expressive figures. This combination was refined and developed later in metalwork or ivories such as the *Cross of Ferdinand I of León*. This style of interlacing continued for a long time in Scandinavian carvings and occasionally in other European sculpture.

About 1100, a revival of monumental sculpture spread along a line from northern Spain to northern Italy, but was centered in southern France. By this time, the Christian church had become a dominant force in Europe. All the new monumental carvings appeared on church property, including church porches and *tympanums* (areas above doorways). The sculptures all showed such religious subjects as Christ enthroned or doomsday scenes. These sculptures may have helped express church doctrines for all classes of people.

At first, monumental sculpture appeared in many styles, apparently based on earlier sarcophagi, ivories, manuscripts, and *frescoes* (wall paintings). By 1135, the *Romanesque* style appeared in a fairly uniform aspect throughout Europe. This style featured elongated fig-



Museo Arqueológico Nacional, Madrid, from Art Reference Bureau

Cross of Ferdinand I of León
From the Church of San Isidoro, León, Spain, about 1063.
Ivory. 21 in. (53 cm) high.

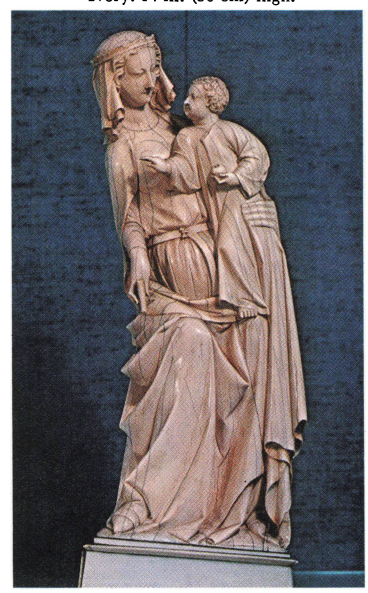
The prophet Isaiah
Relief from the Church of Sainte-Marie, Souillac, France, about 1130.
Stone. Figure life size.

WORLD BOOK photo by Leonard von Matt

Ekkehardt and Uta
Figures from the choir of Naumburg Cathedral. Germany, about 1250.
Stone. Over life size.

Deutsche Fotothek, Dresden, East Germany, from Art Reference Bureau

The Virgin and Child
France (School of Paris), early 1300's.
Ivory. 14 in. (36 cm) high.



Courtesy Victoria and Albert Museum, London, from Art Reference Bureau

WORLD BOOK photo by Leonard von Matt.

St. Wolfgang Altar (detail) by Michael Pacher
Church of St. Wolfgang-am-Abersee, St. Wolfgang, Austria, 1471-1481. Painted wood, partially gilded. Figures approximately life size.

ures with formal, staring faces, and the use of decorative, stylized lines of drapery. These characteristics can be seen in the relief of *the prophet Isaiah* (page 206g).

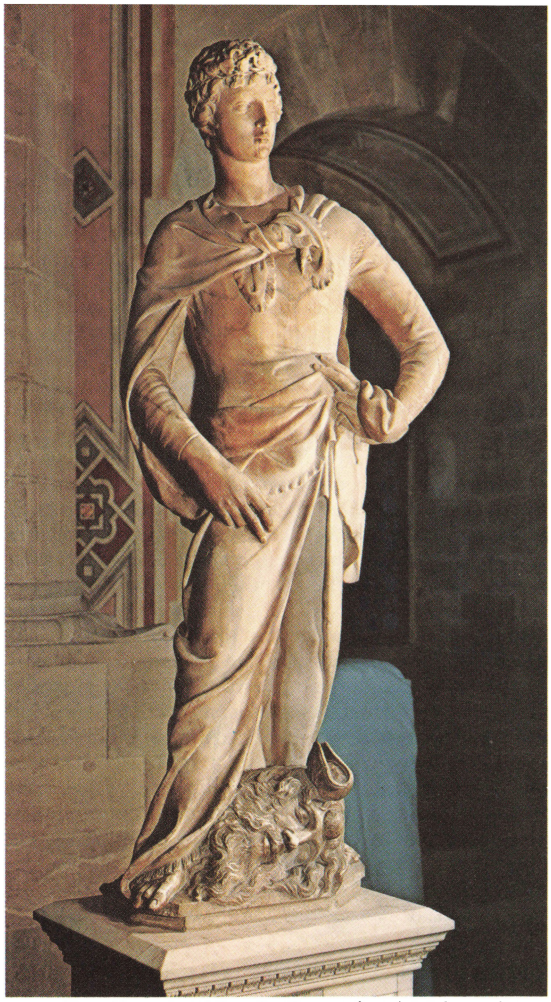
Sculptors continued to devote most of their work to church decoration during the period when the great Gothic cathedrals were being built, from about 1150 to about 1300. The earliest Gothic sculpture appeared in Chartres, Paris, and other cities of northern France. Sculptors created formal, stylized works in which the vertical lines of drapery seemed to serve as additional pillars for the new, soaring Gothic architecture. An example is the detail from the *west portals of Chartres cathedral* on page 193. The faces of the figures look more natural and human than in Romanesque sculpture. This new naturalism grew until, by the mid-1200's, statues expressed the freedom and naturalism that marked the great flowering of Gothic art. The Gothic style quickly spread throughout western Europe. Such figures as *Ekkehardt and Uta* reflect the dignity and crusading idealism of early Gothic art (page 206g).

During the 1200's, sculptured tombs became numerous. At first, sculptors decorated only the tombs of kings and other great persons with *effigies* (figures) of those persons. Soon, members of the lesser nobility, such as knights, arranged for sculptors to carve figures on their tombs. These effigies lying on tombs created a great new outlet for sculpture.

Sculpture of the 1300's reflects the changed political structure of medieval society. A courtly style developed as sculpture came under the influence of the princes and their courts. The effect of this style on sculpture can be seen in the beautiful ivory carving of *the Virgin and Child* on page 206g. Compared with the early Gothic figure of *Uta*, the Virgin looks like a fashionable court lady with affected gestures. These characteristics of affected poses and sweetly smiling faces appeared in both large and small sculptures of the 1300's.

During the 1400's, church construction declined. Instead of decorating church *façades* (fronts), sculptors turned to furnishing the insides of churches and chapels with altars and statues of saints for worship and decoration. This type of carving dominated the sculpture of the 1400's. Workshops in Flanders and southern Germany mass-produced and exported thousands of figures and altarpieces. Most were made of painted wood, and were carved naturalistically. They were created in small sections so they could be transported easily.

Late Gothic sculpture in northern Europe came to a climax between 1490 and 1510. It centered in the great trading towns of Flanders and southern Germany, including Antwerp, Nuremberg, Ulm, Augsburg, and Munich. Many individual styles developed. This expression of a personal artistic style was influenced by artistic developments of the Renaissance in Italy. Outstanding artists of this late Gothic period included Veit Stoss, Tilman Riemenschneider, and Michael Pacher, who carved the great *St. Wolfgang Altar*. As a group, sculptors in northern Europe still followed medieval traditions. Even sculptors most influenced by the Renaissance, including Conrad Meit and the Vischer family, produced Gothic monuments in the 1530's.



Museo Nazionale del Bargello, Florence, from Art Reference Bureau

David by Donatello
Italy, about 1408. Marble. Figure about 5 ft. 2 in. (1.57 m) high.

SCULPTURE / *Italian Renaissance*

Figures made by medieval sculptors of northern Europe represented types rather than individuals, such as the concept of a "good man." But Italian Renaissance sculptors portrayed individual persons—for example, a particular man who was good.

Renaissance sculpture reflected the new outlook on life that appeared in Italy during the 1300's. This outlook, which later scholars termed *humanism*, emphasized the importance of man and his activities. Humanism had its roots in the civilizations of ancient Greece and Rome. The Renaissance was given its name, which means *rebirth*, because of the revival of interest in classical art, architecture, and civilization.

In the late 1200's, Nicola Pisano and his son Giovanni began the revolutionary changes that led up to the Renaissance in Italian sculpture. They were architects and designers as well as sculptors, and are noted for their reliefs and ornamentation on pulpits. *The Massacre of the Innocents* by Giovanni Pisano is an example. The dense composition of this relief shows that the sculptor was inspired by Roman sarcophagi. Its content, in which each person reacts as an individual, shows the new attitude of the Renaissance. The actual carving remains Gothic, however.

During the 1300's, political and economic troubles in Italy limited sculptural activity. But the great revival of art in Florence about 1400 brought two generations of sculptors who were the equals of any artists anywhere at any time. They returned to classical Mediterranean traditions, and turned away from the Gothic style which was more at home in northern Europe.

Early Renaissance. The greatest sculptor of the early Renaissance was Donatello. By 1409, he had produced a stone statue of *David* which, though Biblical in subject matter, was entirely new in spirit—the portrait of a proud, triumphant boy. In a bronze statue of David,

Julius Caesar
by Desiderio da Settignano
Italy, about 1450-1453.
Marble relief. 16½ in. (42 cm) high.

The Louvre, Paris, from Art Reference Bureau

The Massacre of the Innocents by Giovanni Pisano

Detail from a panel of the pulpit in the Church of Sant'Andrea.
Pistoia, Italy, 1298-1301. Marble. 33 in. (84 cm) high.

WORLD BOOK photo by Leonard von Matt

completed about 1430, Donatello revived the use of the nude figure. This statue re-established the classical idea of beauty—the naked human body.

The new naturalness quickly affected sculpture throughout Italy. Donatello decorated the pulpits and singing galleries of churches in Florence and Padua with gay *putti* (singing and dancing children). Luca della Robbia made popular colored terra-cotta figures which were copied for generations. Sculptors also began to make figures of the Virgin Mary whose models might have been attractive local Italian girls. These sculptures differed greatly from the formal, impersonal Romanesque and Gothic types.

Other new forms of sculpture developed during the 1400's, including lifelike portrait busts and great monuments in the classical style. Desiderio da Settignano became famous for portraits, including his relief of *Julius Caesar* (page 206i). Among the other brilliant sculptors of the 1400's were Jacopo della Quercia, Michelozzo Michelozzi, Bernardo and Antonio Rossellino, and Agostino di Duccio.

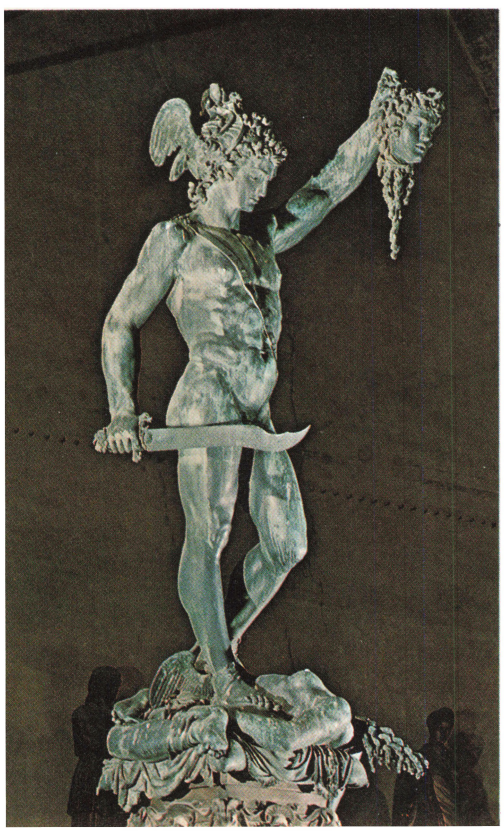
In the mid-1400's, Donatello moved to Padua. His style of modeling became more precise and sharp, and influenced the whole trend of sculpture in northern Italy. Among the sculptors influenced by this new style were the Mantegazza brothers, Giovanni Amadeo, the Lombardi family, and the great bronze worker Andrea Briosco, who was called *Il Riccio*. They all showed rather stylized, flattened planes in their works. Only in later nonreligious works, such as small bronzes and medals, did sculptors return to rounder, classical forms.

Two important sculptors of the late 1400's were Antonio del Pollaiuolo and Andrea del Verrocchio, both of Florence. Pollaiuolo, like Donatello and many other artists of this period, made a careful study of the appearance of muscles while the body is in motion. These artists caught fleeting moments of tense action in their poses. An example is *Hercules and Antaeus* by Pollaiuolo (page 199). Verrocchio designed the powerful, stern *equestrian monument of Bartolommeo Colleoni* (page 195).

Michelangelo. The great flood of Italian genius came to a climax in the early 1500's in Michelangelo Buonarroti. Michelangelo's great brooding sculptures, including the figures of *Evening* and *Dawn* on the *tomb of Lorenzo de' Medici* in Florence, carry the observer beyond earthly reality. The deep feeling and emotion of his figures set them apart from all other works of sculpture of that time.

Most other sculptors of the 1500's produced rather forced adaptations of imperial Roman figures and groups. Some monumental dignity can be seen in the works of such Venetian sculptors as Jacopo Sansovino and Alessandro Vittoria. Other sculptors followed Giovanni da Bologna's experiments in composition in which figures turn and twist in complicated poses. Still others, including Benvenuto Cellini and Bartolommeo Ammannati, developed the *mannerist* style. This style emphasized grace and elegance, and resulted in the creation of slender, artificial figures. An example is Cellini's bronze *statue of Perseus*. See MANNERISM.

Statue of Perseus by Benvenuto Cellini
Italy, 1545-1554. Bronze.
Figure 10½ ft. (3.20 m) high.



Piazza della Signoria, Florence; WORLD BOOK photo by Leonard von Matt

Tomb of Lorenzo de' Medici by Michelangelo
Italy, about 1524-1534. Marble. Figures life size.

Medici Chapel, Florence; WORLD BOOK photo by Leonard von Matt

European Sculpture. The greatest master of European sculpture in the 1600's was Gian Lorenzo Bernini of Italy. Bernini was a superlative craftsman and also an outstanding architect. His sculpture for the *tomb of Pope Alexander VII* shows the wide range of his talent. The work is typical of the *baroque* style of the period because it was designed to appeal primarily to the emotions and senses. Bernini combined emotional and sensual freedom with theatrical presentation and an almost photographic naturalism. Bernini's saints and people seem to sit, stand, and move as living people—and the viewer becomes part of the scene. This involvement of the spectator is a basic characteristic of baroque sculpture.

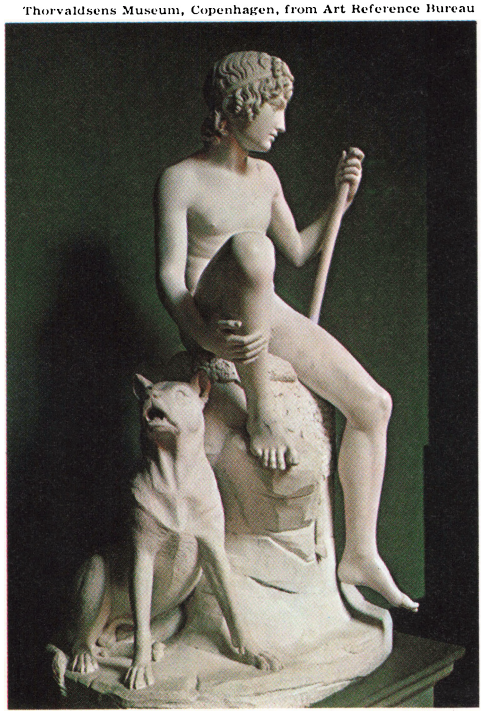
The sculptors who succeeded Bernini in Rome during the late 1600's softened the dynamic and showy baroque style. They used a more static and restrained classical style. These artists were technically skilled, and made hundreds of monuments that filled the churches of the time. By the early 1700's, they had become more interested in technical skill than in content, and their art reflected the change. But these artists had an important influence on sculptors of France and Flanders who made up the Franco-Flemish school.

Franco-Flemish sculptors were responsible for many church and public monuments built in northern Europe during the 1700's. Their sculptures decorated many royal palaces and gardens, including Versailles in France. These artists all followed the same style. They combined naturalistic details with artificial poses and

St. Peter's Church, Rome; WORLD BOOK photo by Leonard von Matt

Tomb of Pope Alexander VII
by Gian Lorenzo Bernini
Italy, 1671-1678. Marble and gilt bronze.
Figures over life size.

A Shepherd Boy by Bertel Thorvaldsen
Denmark, 1817-1825. Marble. 4 ft. 9 in. (1.45 m) high.
Thorvaldsens Museum, Copenhagen, from Art Reference Bureau



Mercury by Antoine Coysevox
France, 1700-1702. Marble. About 10 ft. (3.05 m) high.
Gardens of the Tuileries, Paris; WORLD BOOK photo by Leonard von Matt

gestures, as shown in Antoine Coysevox's statue of *Mercury* (page 206k).

A brilliant new movement called *rococo* grew up. In Germany during the early 1700's, it was led by such artists as Ignaz Gunther and Ferdinand Dietz. Dramatic, colorful, and technically superb, its saints and goddesses mingle in architecture with plasterwork and painted ceilings to create an extraordinary world of fantasy.

The *neoclassical* movement arose in the late 1700's. The members of this vast international school restored what they regarded as classical principles of art. They were direct imitators of ancient Greek sculptors. They emphasized classical drapery and the nude. Leading neoclassical sculptors included Antonio Canova of Italy, John Flaxman of England, and Bertel Thorvaldsen of Denmark. Thorvaldsen's delightful marble statue *A Shepherd Boy* is typical of the neoclassical style (page 206k). This style greatly influenced churchyard and public monuments.

The *romantic* movement began in the 1830's, and existed side by side with neoclassicism until about 1900. Romantic sculpture was sentimental and it appealed to the senses. Leading sculptors who worked in the romantic style included François Rude, Jean Baptiste Carpeaux, and Auguste Rodin, all of France. Such works as Rodin's *Orpheus* emphasize the possibilities of the modeler's technique. Rodin's technique greatly influenced sculpture of the 1900's.

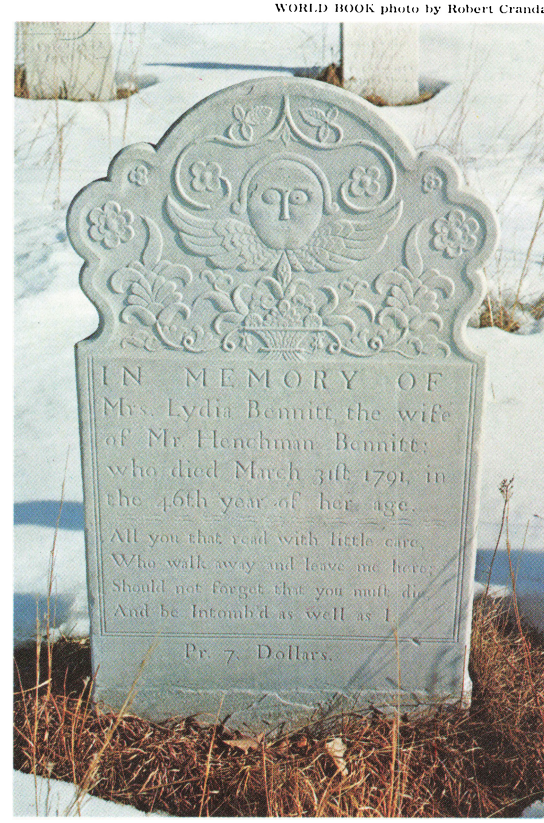
American Sculpture. North America had no professional sculptors until the late 1700's. However, anonymous craftsmen created fine examples of what is called *folk art*. The *gravestone* by Zerubbabel Collins and other gravestones in New England cemeteries reflect Puritan ideals in crude but vigorous reliefs. Many metal weathervanes were designed with fanciful imagination.

The earliest American sculptors made small wax portraits in relief, and decorative figures in wood. The finest of the early wood carvers was William Rush. His *allegorical* (symbolic) figures show the influence of the elegant European rococo style. Jean Antoine Houdon, the greatest French sculptor of his generation, came to America in 1785 to make a portrait statue of George Washington. Several less important Italian sculptors worked on the decorations of the United States Capitol in Washington, D.C., in the early 1800's.

In the 1820's, American sculptors started to go to Italy, where they were greatly influenced by the classical works they saw. Congress commissioned Horatio Greenough to make a colossal marble statue of *George*

Orpheus by Auguste Rodin
France, 1892. Bronze. 4 ft. 11 in. (1.50 m) high.
Musée Rodin, Paris, from Art Reference Bureau

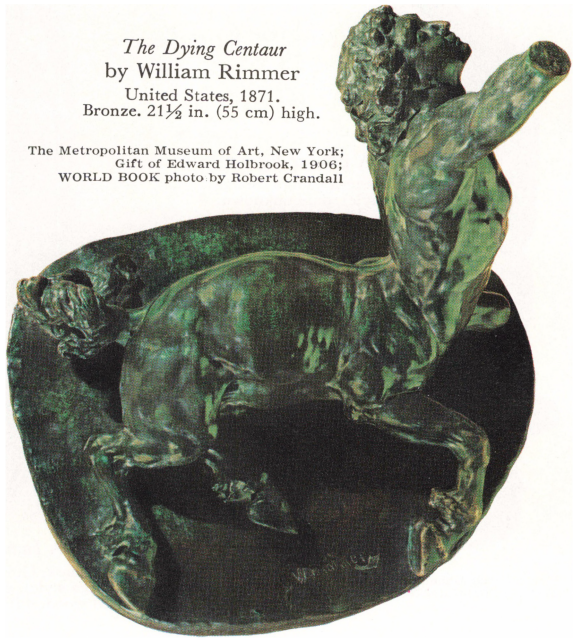
A New England gravestone by Zerubbabel Collins
United States (Columbia, Conn.), 1791. Marble. 31½ in. (80 cm) high.
WORLD BOOK photo by Robert Crandall



Washington. Greenough represented his subject seated, semi-nude, in the pose of the Greek god Zeus. Hiram Powers created smooth and impersonal nude mythological figures, and some remarkable realistic portrait busts of public men. William Rimmer made a few dramatic, struggling figures, including *The Dying Centaur*. These figures were more emotional, powerful, and tragic than earlier American works. They showed a great knowledge of anatomy and a strong feeling of tension. John Rogers made small groups of Civil War scenes, and also created works that suggested the pleasant, warmhearted quality of small-town everyday life.

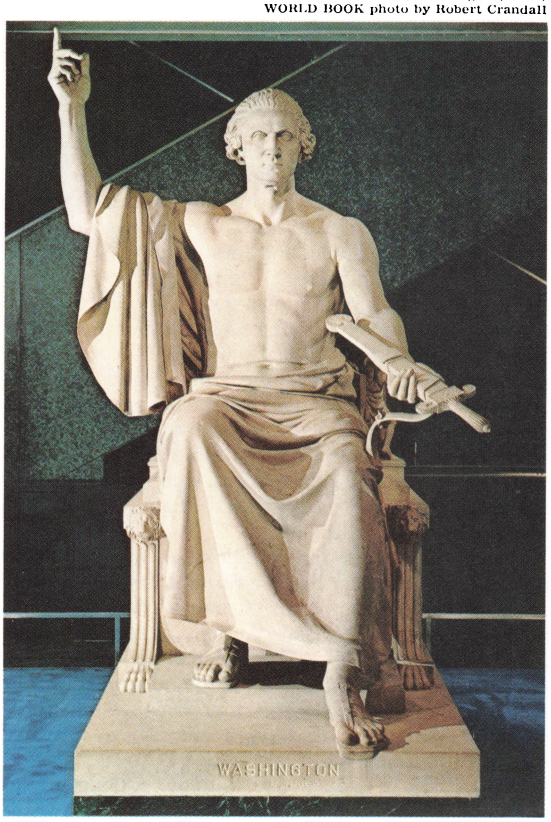
About the mid-1800's, French influence began to be felt more strongly than Italian. The greatest American sculptor of his period was Augustus Saint-Gaudens, best known for his statue of Abraham Lincoln.

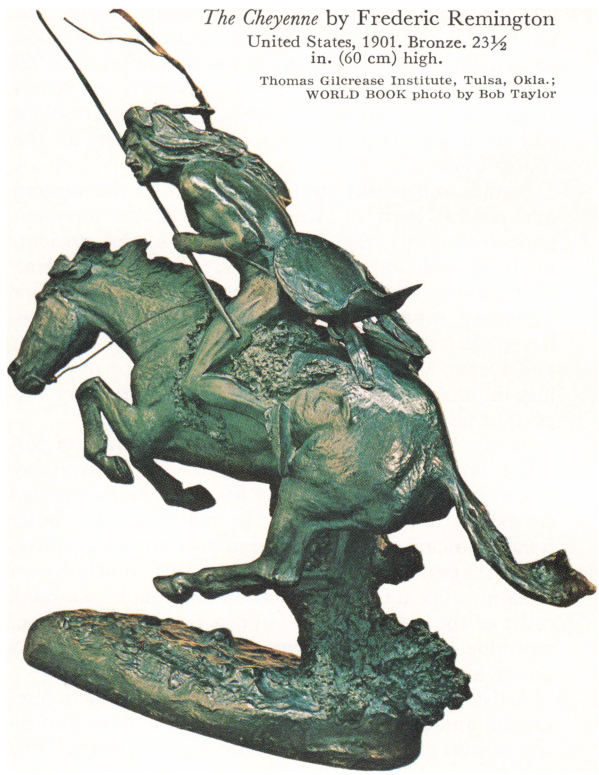
Important sculptors of the late 1800's included Daniel Chester French, who made many serene and idealistic compositions, and George Grey Barnard, master of the expressive human figure. Frederick MacMonnies introduced extravagant and rich surface details into the monumental style. Frederic Remington showed another aspect of American life in his small bronzes. He used vivid, dramatic themes from the life of the Far West in such works as *The Cheyenne*.



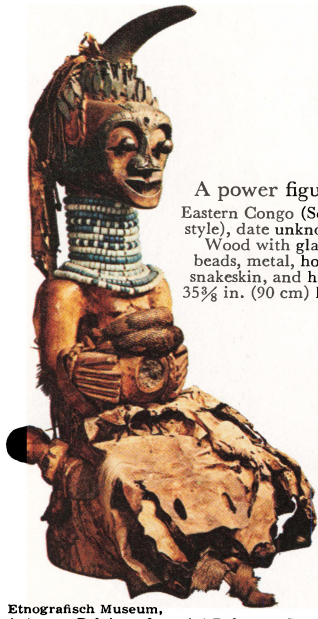
The Dying Centaur by William Rimmer
United States, 1871. Bronze. 21½ in. (55 cm) high.
The Metropolitan Museum of Art, New York; Gift of Edward Holbrook, 1906; WORLD BOOK photo by Robert Crandall

Statue of George Washington by Horatio Greenough
United States, 1840. Marble. 11⅓ ft. (3.45 m) high.
The Smithsonian Institution, Washington, D.C.; WORLD BOOK photo by Robert Crandall



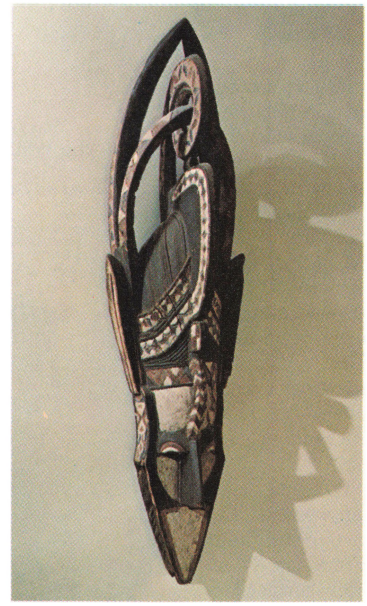


The Cheyenne by Frederic Remington
United States, 1901. Bronze. 23½ in. (60 cm) high.
Thomas Gilcrease Institute, Tulsa, Okla.; WORLD BOOK photo by Bob Taylor



A power figure
Eastern Congo (Songe style), date unknown. Wood with glass beads, metal, horn, snakeskin, and hide. 35⅝ in. (90 cm) high.

Etnografisch Museum, Antwerp, Belgium, from Art Reference Bureau



A *banda* mask
Dance mask, Guinea, western Africa (Baga style), early A.D. 1900's. Painted wood. 4 ft. 8 in. (1.42 m) high.

Museum Rietberg, Zurich, Switzerland; Wettstein and Kauf Foto, from Art Reference Bureau

King Shamba Bolongongo
Portrait of a Kuba king. Central Congo. About A.D. 1650. Wood, partially painted. 22 in. (56 cm) high.

British Museum, London, from Art Reference Bureau

African sculpture consists of figures, masks, and other decorated ceremonial and useful objects. Because most African sculptures were made in perishable materials, such as wood, few of these works are more than 100 or 200 years old. However, works in bronze, ivory, and terra cotta may date back several centuries. The oldest known African sculptures are terra-cotta figures created about 500 B.C. in the Nok culture of Nigeria (see NOK). Wood carvings, terra-cotta works, and bronze castings still are being made in Africa, but increasingly for the tourist trade.

Figures and masks are found mainly in the western and central parts of Africa. Many figures represent ancestors—either the recently dead or the ancient, mythical tribal founders who watch over the well-being of the living. Most masks represent powerful spirits or legendary tribal ancestors. In the past, Africans believed that these spirits and ancestors would seek out and avenge wrong-doing, sanctify the position of youths just initiated into adult society, or perform other important tasks.

Many African figures are carved with details of costume, body decoration, and hairdo seen in everyday life, as in the portrait statue of *King Shamba Bolongongo* carved by a Kuba sculptor. In masks, on the other hand, African sculptors often use contrasting colors, weird shapes, and strange subject matter to achieve an uncanny appearance. The *banda* mask made by a Baga artist of the west coast of Guinea combines antelope, crocodile, and human forms, illustrating its supposed power to pursue evil forces over land and water.

Artists throughout Africa also carve decorated ceremonial and practical objects. Among the most impressive objects are those made for use at royal courts. They include royal stools, neckrests, ceremonial pipes, flywhisks, crowns, staffs, bracelets, containers, cosmetic boxes, doors, and wall ornaments. These objects are elaborately carved to increase a king's importance in the eyes of his subjects and to glorify his office.

Most African sculptures perform more than one function. An example is the Kuba statue of *King Shamba Bolongongo*, a ruler in the central Congo in the mid-1600's. In illustrating the king's fleshy appearance, the statue also shows his health and wealth. In addition, the statue serves to house the king's second soul or "spirit double" which remained behind when the king died or was away on a journey. This statue sums up Kuba thinking about fertility, kingship, and the spirit world.

Much African sculpture shows attempts to gain control over human behavior and spiritual forces by the use of various artistic devices. For example, the people of Benin regarded their king as a god living on earth. In the *altarpiece* on page 198, the king is shown greatly enlarged to signify his political and spiritual power. An attendant on each side of the king suggests the balanced character and good judgment required of a monarch. By contrast, figures made by the Songe people of the eastern Congo serve mainly as *fetishes* (objects with magic power). Beads, horns, and skins attached to the Songe *power figure* activate the figure visually and increase its imagined power.

Despite its remarkable variations, African sculpture reveals a few recurring characteristics. Many of its forms have an expressive rhythm because the same shapes are repeated again and again. Various materials, including cloth, metal, raffia, and feathers, are added to these forms to give the art object a composite appearance in which many distinct textures function together as an ensemble. This emphasis on a cumulative effect is similar to the interweaving of varied instrumental and vocal rhythms so typical of traditional African music. See also AFRICA (The Arts).

The masks and figures of Oceania are even more varied in appearance than are the sculptures of Africa. The islanders of the South Pacific produced sculptures in such extraordinary materials as bark cloth (Melanesia and Easter Island), feathers (Hawaii and New Guinea), cobwebs (New Hebrides), and pieces of turtle shell (Torres Strait). Giant stone figures, also rare in Africa, appear in Tahiti; Easter Island; the Austral, Marquesas, and Solomon Islands; and in several areas of Indonesia. Because most Oceanic sculptures were made of impermanent materials, most surviving works date from a period no earlier than the 1800's. The oldest known specimens probably date from the period between 1000 and 500 B.C.

The chief themes of Oceanic sculpture involve spirits, ancestors, monsters, and gods important to a local community. For example, the Baining people of New Britain make huge *hariecha* images from bamboo, leaves, and bark cloth—that is, from perishable materials. These images represent friendly spirits which are believed to attend the annual ceremony marking both the harvesting of crops and the initiation of boys into adult society.

The Asmat people of New Guinea carve their enormous *bis* poles as memorials to the recently dead. All these dead are believed to be victims of headhunting or witchcraft. The carvings represent gigantic soul boats that carry the souls of the dead and serve as a pledge of revenge by the living. The rough surfaces and bold, contrasting colors of the poles are characteristic of Melanesian art. Asmat sculptors also were probably influenced by Indonesian art. Soul boats have been an important theme in Indonesia since the beginning of Bronze-Iron Age culture there about 500 B.C.

In the Sepik River area of New Guinea, the people make masks of monsters and images of demons with extended tongues. An example is *drum with mask and hornbill*. The Sepik people believe these masks and figures have the power to drive away evil spirits or to harm enemies. The Sepik art style probably was influenced by ideas coming originally from southeast Asia or southern China, where similar demon images existed before 200 B.C. Sculptures resembling the Sepik faces are found in the arts of central Borneo and northern Sumatra. The Maori sculpture of New Zealand also shows a similar style.

The Baining also make bizarre-looking *owl masks* that appear in ceremonies designed to ensure the health and well-being of children. The colossal size, strange shapes, and perishable construction of these masks and figures typify the art of many other Melanesian peoples.

Color is unimportant in Polynesian sculpture. Instead, artists emphasize dignified, solid forms in space. In a unique image of the Polynesian supreme god *Tangaroa*, the god is shown creating the other gods out of his own body. Tangaroa's calm, motionless posture, contrasting with the active poses of the little figures, expresses his seniority and dignity. The Polynesians consider these qualities to be those of a superior social position. Here, too, in spite of the attention given to religious symbols, Oceanic art reveals a concern with rank or social standing.

Drum decorated with mask and hornbill

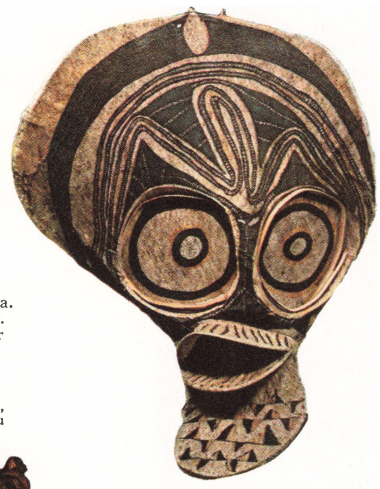
A dance drum from the Sepik River region of New Guinea. Melanesia, early A.D. 1900's. Wood with skin and string. 24 in. (61 cm) high.

British Museum, London, from Art Reference Bureau

Tangaroa (*below*)

Supreme god of Polynesia. Rurutu, Austral Islands. Polynesia, A.D. 1700's or early 1800's. Wood. 45 in. (114 cm) high.

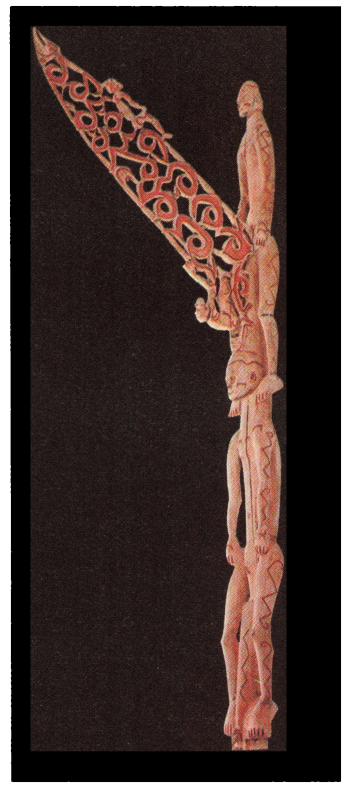
British Museum, London, from Art Reference Bureau



An owl mask

A ceremonial mask of the Baining people of New Britain. Melanesia, date unknown. Cane and bark cloth. 31¼ in. (79 cm) high.

Museum für Völkerkunde, Basel, Switzerland; WORLD BOOK photo by Werner Bruggman



A *bis* pole (*right*)

A memorial pole of the Asmat people of southwestern New Guinea. Melanesia, date unknown. Wood. About 13 ft. (3.96 m) high.

Museum für Völkerkunde, Basel, Switzerland; WORLD BOOK photo by Werner Bruggman

American Indian cultures can be divided into two broad groups—pre-Columbian and tribal American Indian. Pre-Columbian cultures include the Mexican, Peruvian, and other highly developed civilizations which died out soon after the European discovery of the Americas. Tribal Indian cultures include all the less centralized, native peoples of North and South America except the Eskimos.

Pre-Columbian civilizations differed from tribal Indian cultures in having full-time priests, military leaders, traders, and artisans. This specialization enabled pre-Columbian societies to develop complex religions involving calendars and astronomical observations. These societies conquered and governed neighboring peoples and engaged in widespread trade, including the exchange of luxury goods. Specialization also encouraged their artisans to do elaborate work in such difficult materials as stucco, turquoise, and jade. By contrast, the art of tribal Indian communities scarcely approaches the level of sophistication achieved in the pre-Columbian civilizations.

The earliest pre-Columbian civilization, the Olmec, flourished from about 1200 B.C. to about 100 B.C. on the southern Gulf Coast of Mexico. Olmec sculpture consisted primarily of colossal stone heads, rock-cut reliefs, carved boulders, altars, giant stone slabs called *stelae*, and clay and jade figurines. Perhaps the most frequent theme in Olmec art was a half-jaguar, half-baby figure which many scholars identify as a rain god. An example is the jade *figure holding a jaguar-baby*. Olmec sculpture was more monumental in scale and plainer in design than later Mexican art styles. But, like the later styles, Olmec art emphasized ornate costumes and complex arrangements of figures. This emphasis on insignia and spatial organization indicates that the Olmec society was divided into distinct social classes.

After the Olmec culture died out, other major civilizations eventually emerged in Mexico. Among these were: (1) the Teotihuacán civilization, in the central highlands; (2) the Classic Veracruz civilization, on the Gulf Coast; (3) the Monte Alban civilization, centered in the Oaxaca Valley of western Mexico; and (4) the Maya civilizations of southern Mexico, Guatemala, and Honduras. Each of these interrelated cultures produced impressive stone and ceramic sculptures. The Maya made what are probably the finest works, as shown in *Lintel 25 from Yaxchilán*, a relief of a worshiper. The worshiper is offering sacrifices to a serpent-monster that spits out a warlike figure armed with a spear. This relief shows the Maya tendency to combine minute detail with fantastic imagery.

The warlike Toltec, Mixtec, and, later, Aztec cultures end the story of pre-Columbian civilizations in Mexico. The gruesome subject matter and heavy,

Lintel 25 from Yaxchilán

Relief showing a worshiper, *lower right*, kneeling before a double-headed serpent god. Mexico (Mayan style), probably A.D. 680. Stone. About 4 ft. 2 in. (1.27 m) high.

British Museum, London, from Art Reference Bureau

Figure holding a jaguar-baby

Southern Mexico (Olmec style), 1000-300 B.C. Jade. 8⅝ in. (22 cm) high.

Guennol Collection, The Brooklyn Museum, New York

British Museum, London, from Art Reference Bureau

Headdress

Pacific Northwest Coast (Nootka Indian tribe), late A.D. 1790's or early 1800's. Wood inlaid with abalone shell and bone. 7¼ in. (18 cm) high.

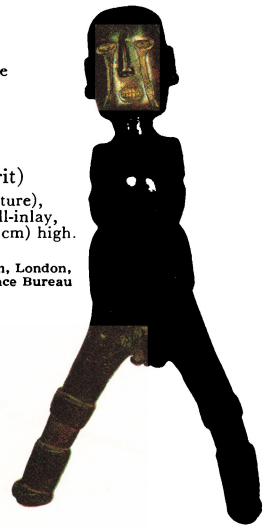


Figure of a *zemi* (spirit)

Jamaica (Arawak Indian culture), date unknown. Wood with shell-inlay, gold, and bark cloth. 40 in. (102 cm) high.

British Museum, London, from Art Reference Bureau

The Art Institute of Chicago; WORLD BOOK photo

Portrait jar

Northern Peru (Mochica style), about A.D. 400-700. Terra cotta. 10¼ in. (26 cm) high.

blocky forms of *Xolotl, an Aztec death god*, illustrate the terrifying Aztec style (page 194).

Pre-Columbian civilizations also reached a high level in Peru and the adjacent regions of the central Andes mountains. The earliest major Peruvian art style is associated with the Chavin culture, which began about 800 B.C. Chavin sculpture consisted mostly of fanged human, jaguar, or bird gods created in stone, gold, shell, or ceramic. The stone *bowl in the form of a jaguar* is an example. Chavin art shares numerous traits with Early Chou art of China of the same date. Many scholars regard Chavin sculpture as one of the clearest instances of transpacific influences in the Americas.

The Mochica civilization flourished on the northern coast of Peru from about 100 B.C. to A.D. 800. Mochica artists modeled many funeral vessels that appear to be naturalistic portraits of important persons, as seen in the *Mochica portrait jar*. This realism eventually gave way to mechanical copying and the use of a few stylized forms in the Tiahuanaco, Chimu, and Inca civilizations that followed.

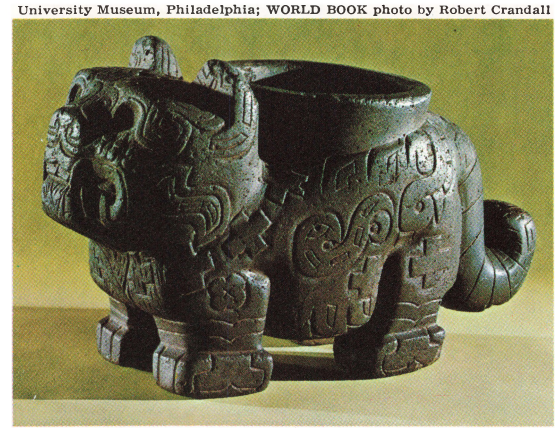
Pre-Columbian and tribal American Indian traditions are mingled together in the sculpture of the Arawak people of the Caribbean islands. In such works as the *zemi* (spirit) *figure*, the use of gold and shell-inlay indicates that these sculptures were produced by a wealthy society divided into social classes. But the simple, nearly nude forms of the body and the lack of insignia of status show that the Arawak culture was not so sophisticated as the pre-Columbian civilizations of Mexico or Peru.

The finest American Indian tribal sculptures are the masks, figures, and totem poles created by the peoples of the Pacific Northwest Coast. Animals, birds, fish, monsters, and spirits appear in such works as the *Nootka Indian headdress*. The animals and spirits are those believed to have given privileges to the founder of a particular family. Scholars have found striking similarities between certain Pacific Northwest Coast themes and the art of ancient China. These similarities suggest contacts between the two civilizations.

Bowl in the form of a jaguar

Peru (Chavin style), about 1200-400 B.C. Stone. 6½ in. (17 cm) high.

University Museum, Philadelphia; WORLD BOOK photo by Robert Crandall



SCULPTURE / *Modern International*

Sculpture of the 1900's has become increasingly international in character as national differences in sculpture have disappeared. Sculptors follow many different styles. Some continue in the classic figure traditions. Others distort and exaggerate the human figure for dramatic and expressive reasons. Still others express the human figure in increasingly abstract ways. Some kinds of earlier art, such as African sculpture, which had not previously influenced European and American artists, became a new source of inspiration.

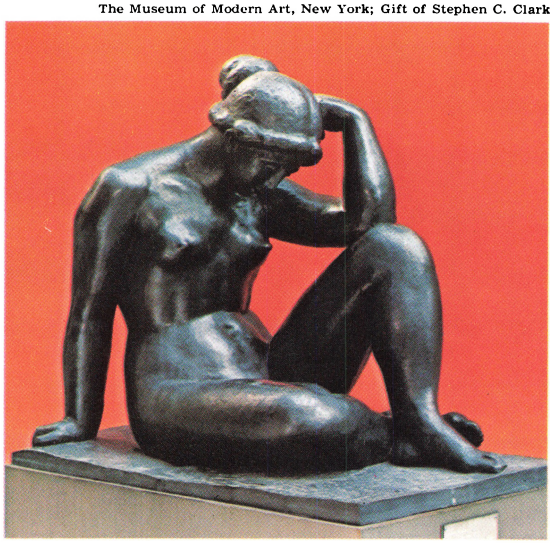
Many sculptors have become more and more interested in problems of pure form, and avoid representational content. As a result, the human figure, which had been the great theme of sculpture for centuries, has become less and less important.

New ways of thinking about sculpture, plus the use of new materials, have resulted in exciting and original developments during the 1900's. A new sense of reality led some artists to introduce actual light and actual movement into their works. New relationships developed between the world of the artist and everyday modern life. One example was the use of fluorescent lights and searchlights in three-dimensional work. Artists also began to use the shapes of modern machines in their works. New materials, many of which were developed for industrial rather than artistic purposes, also had a distinct influence on modern sculpture.

A major influence on all forms of art in the 1900's has been the artist's concern with space. This interest has led to some unusual sculptures because, both historically and technically, sculpture has been an art of mass.

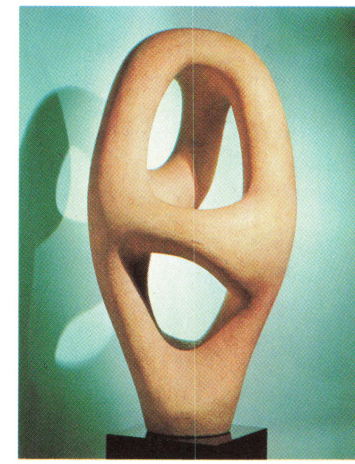
In the early 1900's, the great traditions of classic figure style were upheld by Aristide Maillol of France in such works as *The Mediterranean*. His figures, whether in bronze or marble, have a noble tranquility and an almost Greek purity of form. More recently, beginning in the 1930's, Giacomo Manzù of Italy showed that a deep concern with the human figure is still possible in our time. He combined most of his figures with religious subject matter. There has not been a humanistic relief

The Museum of Modern Art, New York; Gift of Stephen C. Clark



The Mediterranean
by Aristide Maillol
About 1901. Bronze.
41 in. (104 cm) high.

Bird in Space
by Constantin Brancusi
1940. Polished bronze.
4 ft. 4 in. (1.32 m) high.
Collection of
Peggy Guggenheim, Venice;
WORLD BOOK photo
by Erich Lessing, Magnum



Collection of Mr. and Mrs. William A. M. Burden, New York; WORLD BOOK photo by Robert Crandall
Ptolemy by Jean Arp
1953. Cast limestone. 40 in. (102 cm) high.

Man Pointing
by Alberto Giacometti
1947. Bronze. 5 ft. 9¼ in. (1.77 m) high.
The Tate Gallery, London,
from Art Reference Bureau

style of comparable delicacy and power since the Italian Renaissance.

Many sculptors have used the human figure for increasingly expressive and dramatic purposes. These artists often used exaggeration or distortion to increase the intensity and immediate impact of their works. The Swiss sculptor Alberto Giacometti created bronzes of human figures that seem to be increasingly consumed by the active and aggressive space around them. Such works as *Man Pointing* are so thin that they seem to be a kind of painful drawing in space, rather than sculpture in the traditional, three-dimensional sense.

Many new artistic ideas appeared during the years just before World War I began in 1914. *Cubism* and *futurism* were two related movements which led to experiments in both sculpture and painting. Cubist sculptors represented objects in such basic geometrical forms as cubes, cylinders, and cones. Futurist sculptors tried to show how space, movement, and time affect form. These artists portrayed objects in motion, rather than their appearance at any particular time. An example is *Unique Forms of Continuity in Space* by Umberto Boccioni of Italy (page 200). Constantin Brancusi, a Romanian sculptor, gave intense life and character to severely controlled and limited forms. His famous *Bird in Space* (page 206r) suggests soaring movement without attempting to physically portray a bird.

Other sculptors of the period before World War I were increasingly fascinated with problems of pure form. The French artist Jean Arp carved *organic forms* (shapes found in nature), often using white painted wood. He distributed these shapes in delicately calculated arrangements on flat planes. In later works, including *Ptolemy* (page 206r), Arp abandoned these painted reliefs. Instead, he created free-standing shapes that were simplified representations of organic forms.

Many sculptors who worked with pure forms also adopted new industrial materials enthusiastically. The

Collection of Mrs. Robert B. Mayer (WORLD BOOK photo)

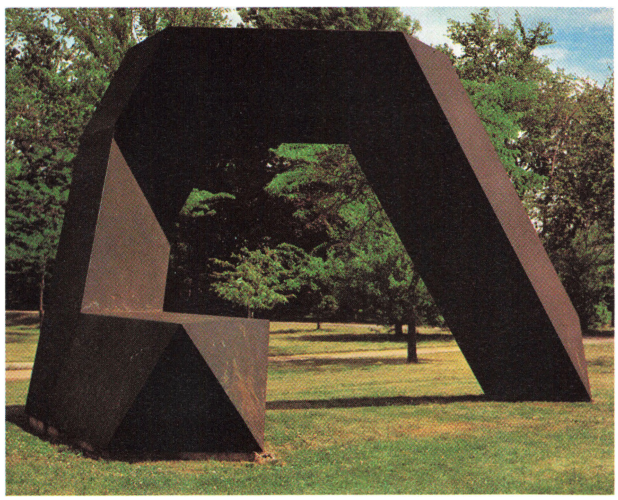
The Family by Marisol

1963. Painted wood and other materials. 6 ft. 7 in. (2 m) high.

Cigarette by Tony Smith

1967. Steel. 15 ft. (4.6 m) high.

Albright-Knox Art Gallery, Buffalo, N.Y., Gift of the Seymour H. Knox Foundation, Inc.



Woman with Suitcases by Duane Hanson

1973. Painted fiberglass and polyester. Life-sized figure.

Collection of Mr. and Mrs. Morton Neumann (O. K. Harris Works of Art)

Spiral Jetty
by Robert Smithson
Great Salt Lake, Utah,
1970. Rocks.
Coil 1,500 ft. (457 m) long.

Gianfranco Gorgoni

Russian-born sculptor Naum Gabo used metal, plastics, and wire, and his works are remarkable examples of the use of these new materials. Alexander Calder used metal and wire shapes in such mobiles as *Red Petals* (page 200). Louise Nevelson, an American sculptor, assembled machine-made wooden objects into extraordinary sculptures. Many of her works are complex compartments which seem to open into or to suggest eternity. The interest in actual movement in sculpture is brilliantly shown in the work of José de Rivera of the United States. His elegant, twisted steel forms move mechanically and rotate slowly. The works of the American sculptor David Smith are much more dramatic and forceful (page 194). Richard Lippold of the United States creates wire designs of refined architectural quality in such works as *Variation Number 7: Full Moon* (page 193).

Other sculptors did not abandon the representation of human and animal forms, but handled these forms in significant new ways. Jacques Lipchitz, an American sculptor, is probably best known for his powerful and expressive figures, which are full of symbolic movement. Henry Moore of England makes vast reclining wood or stone figures (page 203). Holes in the figures allow space to move freely through the massive blocks of material. Theodore Roszak of the United States shapes rough textured forms of metal which are not identifiable images of men or animals. They have a strong sense of organic form, however, and seem to grow physically in space.

The machine, which plays such a basic role in modern life, has become an important influence on artistic developments. Not only have machine forms and industrial materials become part of the present-day art world, but the actual machine is being used as an artistic material. The American sculptor Richard Stankiewicz uses wheels, boilers, chains, bolts, and other actual mechanical parts. He puts them together in new ways and often gives them a dramatically humanistic quality.

Some young artists have avoided the use of machine parts, but have created works that appear to have been produced by machines. These sculptors have produced forms in aluminum, plastics, and other industrial materials which remain severely geometrical, deliberately anonymous, and almost totally impersonal. Such work has been called *minimal art*. In *Cigarette* (page 206s), the American sculptor Tony Smith created a work that is clear, simple, and based on elementary geometric forms and relationships. Like other minimal artists, Smith deliberately avoided self-expression. *Cigarette* suggests no recognizable ideas or images. Its impact lies in the material used and the proportional relationships of the parts. In many ways, Smith worked like an engineer rather than a traditional artist.

Some sculptors have created works, often called *environmental sculpture*, that are actually a part of the world of nature. Environmental sculptures include trenches dug in deserts, as well as surfaces of rock. Some environmental sculptors have even used bodies of water and air currents in their works. Robert Smithson's *Spiral Jetty*, a construction in the Great Salt Lake in Utah, has no functional purpose. Smithson, an American sculptor, created it simply to be contemplated for its own sake.

A number of sculptors have rejected the abstract qualities of minimal and environmental art. These artists have developed a style of extreme realism that involves ordinary subjects. For example, *Woman with Suitcases* (page 206s), by Duane Hanson of the United States, is a realistic human figure. The woman has natural color and real hair, clothes, and accessories. The realism of the work almost fools viewers into thinking they are looking at a living person. Sculptors who work in this style seem to break down the barriers that once separated art from life.

The distinction between sculpture and other art forms has become less definite. Artists create sculptures from shaped and painted canvas, solid colored forms, and combinations of many materials. In *The Family* (page 206s), the American sculptor Marisol wittily combined painting and sculpture with objects of actual clothing and furniture. She often introduces plaster casts of her own face and hands in her work. MULK RAJ ANAND, JOHN BOARDMAN, DOUGLAS FRASER, H. D. MOLESWORTH, BERNARD MYERS, SIR HERBERT READ, and ALLEN S. WELLER

Critically reviewed by SIR HERBERT READ

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Fraser, James E.
French, Daniel C.
Gabo, Naum
Greenough, Horatio
Lipchitz, Jacques
Lippold, Richard
Manship, Paul
Milles, Carl W. E.
Nevelson, Louise
Noguchi, Isamu
Powers, Hiram
Remington, Frederic
Roszak, Theodore
Russell, Charles M.
Saint-Gaudens, Augustus
Segal, George
Smith, David
Taft, Lorado
Zorach, William

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Barye, Antoine L.
Brancusi, Constantin
Coysevox, Antoine
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Houdon, Jean A.
Maillol, Aristide
Pevsner, Antoine
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Pisano (family)
Pollaiuolo, Antonio del
Verrocchio, Andrea del

OTHER SCULPTORS

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Epstein, Sir Jacob
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Lysippus
Mestrovic, Ivan
Moore, Henry
Phidias
Picasso, Pablo
Praxiteles
Thorvaldsen, Bertel

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Liberty, Statue of
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Tanagra Figurines
Venus de Milo
Winged Bull
Winged Lion
Winged Victory

HISTORY OF SCULPTURE

Ancient Civilization
Assyria (Art and Architecture; pictures)
Aztec (The Arts)
Babylonia (Art; picture)
Egypt, Ancient (The Arts; pictures)
Etruscan (Language and Culture; pictures)
Greece, Ancient (The Arts)
Indian, American (Arts and Crafts)
Maya (The Arts; pictures)
Persia, Ancient (pictures)
Roman Empire (The Arts)

KINDS OF SCULPTURE

Bust
Carving
Collage
Gargoyle
Idol
Intaglio
Mask
Mobile
Relief
Sarcophagus

METHODS AND MATERIALS

Alabaster
Bronze
Cast and Casting
Clay
Ebony
Fiber Glass
Iron and Steel
Ivory
Jade
Lacquer
Marble
Plaster of Paris
Plasticine
Plastics
Terra Cotta
Welding
Wood Carving

STYLES

Baroque
Byzantine Art
Carolingian Art
Classicism
Cubism
Futurism
Gothic Art
Humanism
Impressionism
Renaissance
Rococo
Romanticism

OTHER RELATED ARTICLES

Africa (The Arts)
Art and the Arts
Asia (Way of Life)
Australia (Arts)
Design
Europe (Arts)
Latin America (Arts)
Pop Art

Outline

I. The Importance of Sculpture
II. The Sculptor at Work
III. Sculpture as an Art Form
IV. Looking at Sculpture
V. The Beginnings
VI. Oriental Sculpture
VII. Greek Sculpture
VIII. Etruscan and Roman Sculpture
IX. Medieval Sculpture
X. Italian Renaissance Sculpture
XI. 1600-1900
XII. African Sculpture
XIII. Pacific Islands Sculpture
XIV. American Indian Sculpture
XV. Modern International Sculpture

Questions

Why did prehistoric peoples create sculpture?
What is the lost-wax method of casting?
In what type of sculpture did the Romans excel?
What is (a) sculpture in the round? (b) relief sculpture?
How can sculptors create the illusion of movement?
What is the purpose of sculpture in Oriental civilizations?
How can we develop an appreciation of the qualities of sculpture?
What rules did Egyptian sculptors follow when carving the human figure?
Why have some modern sculptors avoided representations of human and animal figures?
What is an armature? How and why is it used?

Reading and Study Guide

For a *Reading and Study Guide on Sculpture*, see the RESEARCH GUIDE/INDEX, Volume 22.

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SCUP is the common name for a fish that lives in the Atlantic Ocean. Scups are about 18 inches (46 centimeters) long and weigh about 4 pounds (1.8 kilograms). They live on the ocean bottom.

Scientific Classification. The scup is in the porgy family, *Sparidae*. It is classified as genus *Stenotomus*, species *S. chrysops*. LEONARD P. SCHULTZ

SCURVY is a disease caused by lack of *ascorbic acid* (vitamin C) in the diet. Foods especially rich in this vitamin include citrus fruits, tomatoes (raw or cooked), raw cabbage and lettuce, celery and onions, cress, fresh carrots, and potatoes. These foods must be fresh to be useful in supplying vitamin C.

If a person does not get enough vitamin C, any wound he might have heals poorly. He also bruises easily. The walls of the *capillaries* (small blood vessels) become so weak that slight pressure may cause them to break. The mouth and gums become sore. The gums bleed and the teeth may become loose. The patient loses his appetite, his joints become sore, and he becomes restless. Anemia may also develop.

Foods that contain vitamin C prevent scurvy. They will also cure most cases of scurvy. Proper sanitary habits are also important. Treatment may include the use of antiseptic mouth lotions and vitamin C tablets.

Scurvy was once a common disease among sailors. During long voyages, sailors rarely had fresh fruits and vegetables. They lived on salt beef and *hardtack* (dry biscuits) for weeks at a time. Portuguese navigator Vasco da Gama once lost 100 out of 160 men from scurvy. In 1753, James Lind, a Scottish physician, recommended adding lemon juice to sailors' diets to prevent the disease. In 1795, the British Navy followed his advice and began issuing daily rations of juice to its men. At that time, the juice of lemons was often called *lime juice*. British sailors got the nickname *limeys* from their practice of drinking lemon juice.

Improved understanding of food requirements has made scurvy rare. Today, scurvy is mainly a disease of babies and elderly persons whose diets are inadequate. Scurvy in infants is called *Barlow's disease*. It usually occurs when breast feeding stops. Bottle-fed babies should drink orange juice or tomato juice after the first month. Mothers should give fruit juices regularly to infants learning to drink from a cup. J. F. A. MCMANUS

See also VITAMIN (Vitamin C).

SCUTCHING. See FLAX (Processing Fiber Flax).

SCYLLA, *SIL uh*, in Greek mythology, was at first a beautiful nymph. The sea-god Glaucus fell in love with her when he saw her walking on the shore by the Strait of Messina. She would not love him, and so he went for help to the sorceress, Circe. Circe asked him to love her instead of Scylla, but he would not. In a rage, Circe turned Scylla into a sea monster, part woman and part fish, with heads of dogs growing out of her waist.

Scylla then lived in a cave above the Strait of Messina opposite the whirlpool Charybdis. She seized and ate sailors that came too close. When Ulysses passed that way, she seized six of his men (see ODYSSEY; ULYSSES). Sailors who went through the Strait tried to steer a middle course *between Scylla and Charybdis*. This expression is sometimes used when a person speaks of having to take a course between two evils. JOSEPH FONTENROSE

SCYTHE, *sithe*, is a hand-harvesting implement with a curved cutting blade. It has a long, bent wood handle, called a *snath*, with a short bar for each hand, distinguishing it from the *sickle*, that has a short handle for one hand. The *cradle scythe* has fingers or light rods which receive the grain and lay it in even *gavels* on the stubble in the field. See REAPING MACHINE. A. D. LONGHOUSE

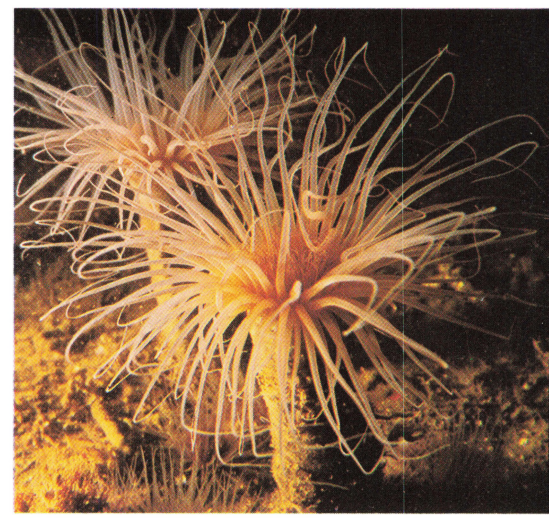
SCYTHIAN, *SITH ih un*, was a member of an ancient group of nomads that lived in southern and eastern Europe between the 600's B.C. and the A.D. 100's. The Scythians wandered from southern Russia, near the Black Sea, eastward to the Altai Mountains in central Asia. They also went westward into what are now Bulgaria, Romania, Hungary, Poland, and East Germany. They were defeated by the Sarmatians, another nomadic tribe, in the 200's B.C., and were completely wiped out by the Goths in the A.D. 100's.

The Scythians were wealthy and somewhat cultured. They decorated their jewelry and implements with distinctive animal designs, which influenced the arts of other European peoples. Historians do not know if the jewelry and implements were made by Scythians or by the Greeks with whom they traded. Their jewelry, horses, and weapons were buried with them when they died. Each chieftain's grave also included one of his wives and several servants, who were strangled. Graves were covered with mounds of earth. JACOB J. FINKELSTEIN

SEA. See OCEAN.

SEA ANEMONE, *uh NEM oh nee*, is a sea animal that looks like a flower called the *anemone*. The shape of the animal's body and its bright color give it a plantlike appearance. Its body may be blue, green, pink, red, or a combination of colors. The sea anemone can move slowly. But it usually remains fixed to a rock or other surface. Sea anemones are *coelenterates*, the group of water animals that also includes the corals, hydras, and jellyfish. The sea anemone's body diameter varies from about $\frac{1}{4}$ inch (6 millimeters) in some *species* (kinds) to more than 3 feet (91 centimeters) in the giant sea anemone of Australia.

Like some other coelenterates, sea anemones are



Al Giddings, Bruce Coleman Inc.

A Sea Anemone has a cylinder-shaped body topped by many *tentacles* (tiny arms), which surround the animal's mouth.

polyps. One end of the cylinder-shaped body attaches to rocks, shells, or wharf pilings. The other points out from the surface. This end has a mouth surrounded by *tentacles* (tiny arms). Sea anemones capture food with their tentacles. Stinging cells in the tentacles throw out tiny poison threads that paralyze other small sea animals and tiny fish. The tentacles drag the prey into the mouth. The mouth leads to a large cavity, where the food is digested. When a sea anemone is disturbed, it pulls in its tentacles and shortens its body. It then looks like a round lump on a rock.

A sea anemone reproduces by forming eggs, by dividing in half, or by *budding*. When it buds, a young sea anemone grows out of the base of the parent's body. Eventually, it breaks off and grows by itself.

Scientific Classification. Sea anemones belong to the phylum *Coelenterata*. They are classified in the class *Anthozoa*. ROBERT D. BARNES

See also ANIMAL (color picture: Animals of the Oceans); OCEAN (color picture: Benthos).

SEA ANIMAL. See MARINE BIOLOGY with its list of *Related Articles*.

SEA ARROW. See SQUID.

SEA BASS. See BASS; JEWFISH.

SEA BAT is a fish with a batlike shape and stubby armlike fins. Its snout juts forward and is covered with small sensitive projections. Its body has a bony covering. Sea bats live in the warm waters of the western Atlantic Ocean. Sea bats are also called *batfish*.

Scientific Classification. Sea bats belong to the batfish family, *Ogcocephalidae*. The common sea bat is classified as genus *Ogcocephalus*. LEONARD P. SCHULTZ

SEA BIRD. See BIRD and the separate articles on Oceanic Birds listed in the Related Articles section.

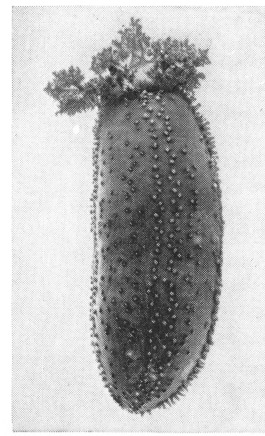
SEA COW is a term sometimes applied to the dugong and manatee, which belong to an *order* (group) of sea mammals called *Sirenia*. But the term more correctly applies to an extinct animal called *Steller's sea cow*.

The Steller's sea cow was discovered in 1741 near the Commander Islands in the Bering Sea. The total population then probably numbered between 1,000 to 2,000. Sailors killed the animals for food, and by 1768 they were extinct. The Steller's sea cow lived in shallow water near shore. It fed on seaweed. It was the largest sirenian and the only one adapted to cold water. It grew about 23 feet (7 meters) long and weighed almost 9,000 pounds (4,100 kilograms).

Scientific Classification. The Steller's sea cow belongs to the order *Sirenia*. It is in the family *Dugongidae*. It is genus *Hydrodamalis*, species *H. stelleri*. KARL W. KENYON

See also DUGONG; MANATEE; SIRENIA.

SEA CUCUMBER is a sea animal with a cylinder-shaped body that looks like a cucumber. It belongs to a group that includes sea lilies, sea urchins, and starfish. The sea cucumber either lies on one side on the sea bottom or burrows in the sand. Its mouth is at one end of the body. Ten branching tentacles encircle the mouth. The animal can lengthen and shorten these tentacles, which catch food and sweep it into the mouth. There are five double rows of *tube feet* on the body, and some sea cucumbers use them to crawl. Some can also throw out sticky, threadlike tubes from inside their body to block an attacker's movements. The sea cucumber then grows new tubes.



American Museum of Natural History

Sea Cucumber

About 500 *species* (kinds) of sea cucumbers live in the oceans of the world. Those living in tropical waters may grow 2 to 3 feet (61 to 91 centimeters) long. Most sea cucumbers in temperate waters grow less than 1 foot (30 centimeters) long. Many sea cucumbers are caught in Indonesia, where they are dried and sent to Chinese markets as a food called *trepang*.

Scientific Classification. Sea cucumbers belong to the phylum *Echinodermata*. They make up the sea cucumber class, *Holothuroidea*. ROBERT D. BARNES

See also ECHINODERM; TREPANG.

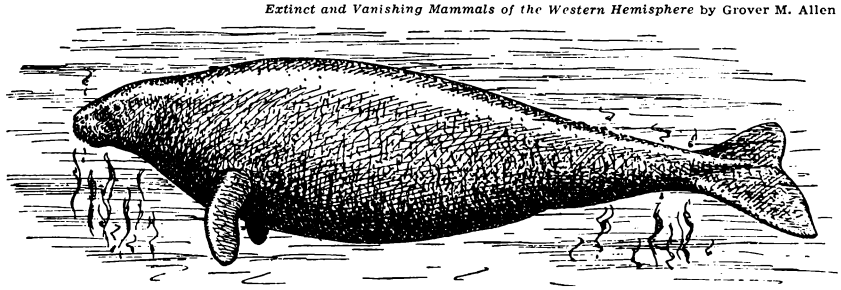
SEA DOG. During the Elizabethan Age (late 1500's), English pirates and privateers who raided Spanish towns and shipping in America and nearby waters were called *sea dogs*. Their attacks threatened Spanish holdings and nearly drove the Spanish fleet from the seas. Today, the term is applied to any experienced sailor.

SEA ELEPHANT, or ELEPHANT SEAL. See SEAL.

SEA FAN is a colorful coral with a flat, fanlike shape. It is made of a horny material called *gorgonin*. The fan has many openings, and grows about 2 feet (61 centimeters) tall. Sea fans live in shallow water at the bottom of the sea, especially in parts of the Pacific Ocean and along the Atlantic Coast near Florida, Bermuda, and the West Indies. They are known for their yellow, orange, red, and purple colors. See also CORAL.

Scientific Classification. Sea fans belong to the family *Gorgoniidae*. The sea fan is genus *Gorgonia*, species *G. flabellum*. LEONARD P. SCHULTZ

Extinct and Vanishing Mammals of the Western Hemisphere by Grover M. Allen

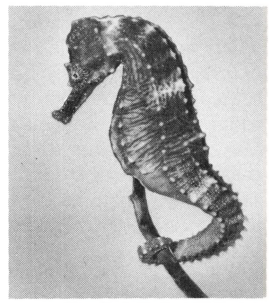


Steller's Sea Cow lived in shallow water near shore. It became extinct a few years after its discovery in 1741.

SEA GULL, any gull found on or near the sea. See GULL.

SEA HORSE is a small, odd-shaped fish that lives in the sea. The sea horse is so named because its head resembles that of a tiny horse. Another name for the sea horse is a scientific term, *Hippocampus*, which comes from Greek words meaning *horse* and *sea monster*. The sea horse is in the same family as pipefishes. Numerous species live in tropical and temperate waters.

The sea horse has a long snout and prominent eyes. The body is about 5 inches (13 centimeters) long, and is covered by spiny, armorlike, bony plates that protect it. It ends in a long tail, which can coil around objects. A tail of this kind is called *prehensile*. The sea horse uses its tail to cling to rooted plants or growths of floating sea vegetation. It moves about in an upright position, weakly swimming with its dorsal fin. It is usually carried along by the currents.



New York Zoological Society

Sea Horse

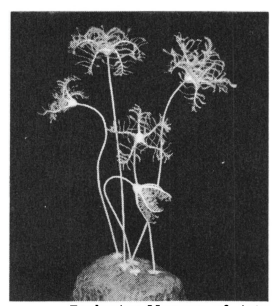
Sea horses mate in the spring and summer. The female lays about 200 eggs, and the male keeps them in a pouch located on the underside of his body until the eggs hatch. Sea horses live for as long as six years.

Scientific Classification. The sea horse belongs to the pipefish family, *Syngnathidae*. The sea horse found along the Atlantic Coast of the United States is genus *Hippocampus*, species *H. hudsonius*. LEONARD P. SCHULTZ

SEA LEOPARD, or LEOPARD SEAL. See ANTARCTICA (Seals and Whales; picture: Animal Life).

SEA LEVEL is the level of ocean waters. It is not the same in all parts of the world, and it changes with every tide. For purposes of measurement, a definite average of sea levels at various times has been agreed upon by scientists who must use the figures. Geographers use mean, or average, sea level as a starting point for measuring height or depth on earth. For example, Mount McKinley in Alaska is 20,320 feet (6,194 meters) *above* sea level. Death Valley, in California, is 282 feet (86 meters) *below* sea level. SIGISMOND DER. DIETTRICH

SEA LILY belongs to a class of lovely sea animals called *crinoids*. The animals have arms and stalks that make them look like flowers. They get their name from this appearance. Crinoids were abundant in past ages, but only a few kinds exist today.



Rochester Museum of Arts and Sciences

Sea Lily

Sea lilies usually live in the deep waters of all the seas. A long stalk attaches a typical sea lily to the sea bottom. The main part of the body, called the *calyx*, is at the top of the stalk. The calyx contains the animal's vital organs. Five featherlike arms branch out from the calyx. The arms screen out tiny plants and animals from the water. This food is passed in grooves to the mouth, which is in the center of the top of the calyx. *Feather stars* are in the same animal class as sea lilies. They have no stalks and are not attached to the sea bottom. They swim by moving their arms. Most feather stars live in tropical seas. There are many more species of feather stars than sea lilies.

Scientific Classification. Sea lilies and feather stars belong to the phylum *Echinodermata*. These sea animals make up the class *Crinoidea*. ROBERT D. BARNES

See also OCEAN (color picture: Benthos).

SEA LION. See SEAL.

SEA MAMMAL is a mammal that lives in the sea. See CETACEAN; DOLPHIN; DUGONG; PORPOISE; SEA COW; SEA OTTER; SEAL; SIRENIA; WALRUS; WHALE.

SEA NECKLACE. See CONCH.

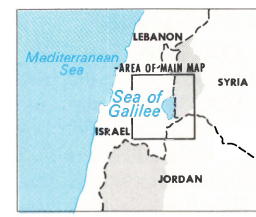
SEA OF CORTES. See GULF OF CALIFORNIA.

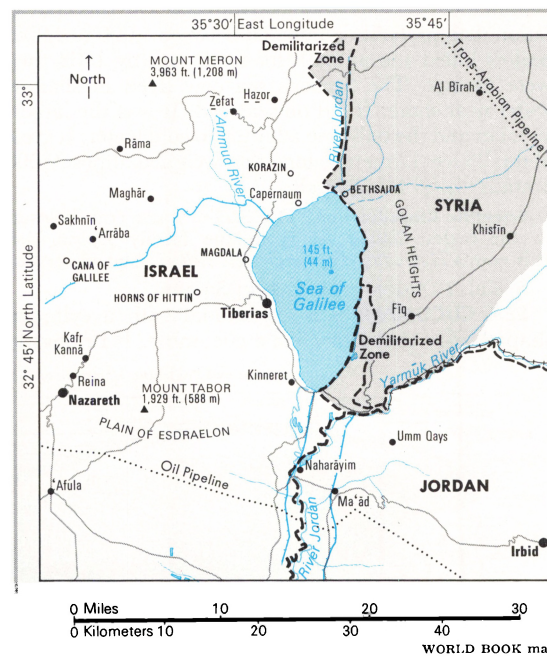
SEA OF GALILEE is a small fresh-water lake in the northern district of Palestine. It is often mentioned in the Bible. The sea is called the *Sea of Chinnereth* in the Old Testament. The name Galilee is used in the New Testament. This sea is also called *Gennesaret*, for the plain that lies to the northwest, and *Tiberias*, for a city on its shore. The sea is also known as *Lake Kinnereth*.

The Sea of Galilee lies on the Jordan plain in Israel, 30 miles (48 kilometers) from the Mediterranean. It touches Syria on the northeast. For location, see ISRAEL (color map). The River Jordan flows through the Sea of

SEA OF GALILEE

Area: 64 sq. mi. (166 km²)
Elevation: 688 ft. (210 m) below sea level
Deepest point: 145 ft. (44 m)





WORLD BOOK map

Galilee on its southward course to the Dead Sea, into which it empties. The Sea of Galilee is 14 miles (23 kilometers) long and 8 miles (13 kilometers) across at its broadest point. Many fish live in it. Gently sloping hills lie along the shores, except where the plain of Gennesaret meets the sea. Figs, olives, dates, and pomegranates grow on the southern hills.

The ancient cities of Magdala, Capernaum, and Bethsaida were once situated on the northern shores of Galilee. Today, only ruins of them remain.

It was beside the Sea of Galilee that Jesus performed a miracle to feed loaves and fishes to a large gathering (John 6: 1-14). Another Bible story tells of Jesus' walk along the shore to recruit disciples from among the fishermen (Matt. 4: 17-20). LOYAL DURAND, JR.

SEA OF JAPAN, BATTLE OF THE. See RUSSO-JAPANESE WAR (Last Battles).

SEA ONION. See SQUILL.

SEA OTTER is a furry animal that lives in the North Pacific Ocean. Herds of these otters dwell near the rocky shores of western North America and Siberia. Sea otters seldom leave the water.

The sea otter swims mostly on its back and uses its flipper-shaped hind feet to paddle. It also eats and

Ron Church

The Sea Otter eats its food, such as squid, above, while floating on its back. It rolls over frequently to wash away scraps.

sleeps while floating on its back. Sea otters often sleep in masses of floating seaweed called *kelp*. The female carries her baby on her chest as she paddles about on her back. She has one baby, called a *pup*, at a time.

Most sea otters grow from 4 to 5 feet (1.2 to 1.5 meters) long and may weigh up to 85 pounds (39 kilograms). Their thick brown fur traps air that keeps their skin dry and insulates them against the cold. The sea otter dives as deep as 180 feet (55 meters) for food and can stay under water as long as four minutes. It uses its front paws for grasping and holding, as do some otters that live in fresh water. For information about fresh-water otters, see the WORLD BOOK article on OTTER.

Sea otters may eat as much as a fifth of their body weight every day. They feed on abalones, clams, crabs, fish, mussels, octopuses, sea urchins, and squids. Sea otters pry open shellfish in various ways. They use their teeth or their paws, and may pound one clam or mussel against another. A sea otter also may balance a rock on its belly and hammer the shellfish against it.

For centuries, sea otters have been hunted for their valuable fur. From the mid-1700's through the 1800's, fur traders killed so many sea otters that the animal almost disappeared. In 1911, Canada, Japan, Russia, and the United States signed a treaty that prohibited the hunting of sea otters. As a result, the world's sea otter population is increasing steadily.

Scientific Classification. Sea otters belong to the weasel family, *Mustelidae*. They make up the genus *Enhydra*, species *E. lutris*. KARL W. KENYON

SEA PARROT. See PUFFIN.

SEA PIE. See OYSTER CATCHER.

SEA PIGEON. See GUILLEMOT.

SEA PLANT. See MARINE BIOLOGY with its list of Related Articles.

SEA SERPENT is a large, probably imaginary marine creature. Since ancient times, the legends of most peoples have told of such creatures as sea serpents, dragons, and unicorns. Witnesses have reported seeing sea serpents, but none of the snakelike monsters has ever been caught or washed ashore.

A sea serpent is probably just a group of leaping porpoises or a floating mass of giant seaweed. Other marine animals, including large eels, oarfish, sharks, and giant sea squids, have also been mistaken for sea serpents. Some scientists believe sea serpents may be real and perhaps are the descendants of a prehistoric animal. The "Loch Ness Monster" is a famous sea serpent that supposedly has lived in a Scottish lake since the 500's. ALAN DUNDES

See also LOCH NESS.

SEA SHELLS. See SHELL.

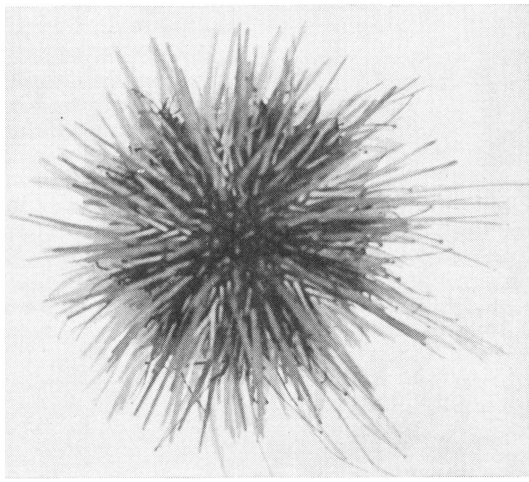
SEA SQUIRT is a name for a group of sea animals which are also called *ascidians*. These animals have a habit of squirting out water through one of two body openings. Adult sea squirts have leathery bottle-shaped bodies. All their adult lives they remain attached to stones, shells, and other fixed objects. Some live together in colonies. The adult animal receives its food from water which it draws into the digestive tract through one of the body openings, the mouth. It squirts out the water from the other opening, the *atriopore*.

Russ Kinne, Photo Researchers

A Sea Squirt is a jellylike animal that lives on the bottom of the ocean.

Sea squirts go through a larval stage before they become mature. The larva looks like a tadpole and can swim about. It has a *notochord* (elastic rod), that extends through the tail. Because of this "backbone," scientists think sea squirts are relatives of the simplest fishlike animals, *lancelets* and *lampreys*. In a few days, the larva loses its tadpole shape and settles on the ocean floor. Soon it develops its adult form.

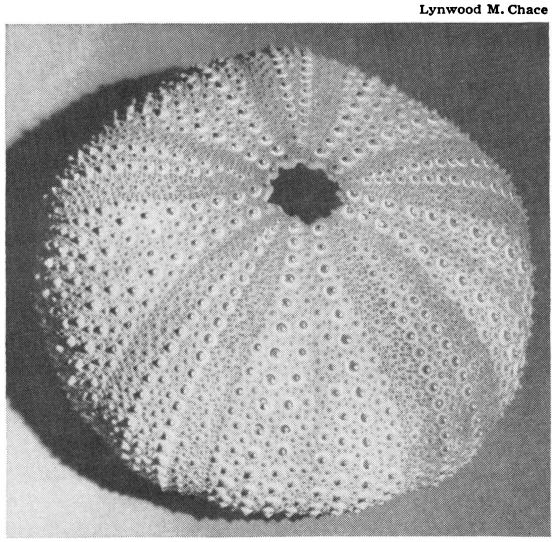
Scientific Classification. The sea squirt is a member of the subphylum *Tunicata*. It makes up the class *Ascidiacea*. LEONARD P. SCHULTZ



Ralph Buchsbaum

A Sea Urchin, *above,* may grow up to 7 inches (18 centimeters) in diameter. Long, sharp spines stick out from its body. The spines grow from a hard, limestone shell, *below,* that protects the animal's soft body. Sea urchins' shells make attractive ornaments.

Lynwood M. Chace



SEA STAR. See STARFISH.

SEA TROUT. See WEAKFISH.

SEA URCHIN is a sea animal. Its body is shaped like a ball and is covered with long, movable spines. Close-fitting limestone plates lie just under the skin and form an internal shell called a *test.* The long spines grow from these plates and stick out through the skin. The sea urchin is in the same animal group as the starfish, sea lily, sand dollar, and sea cucumber.

Sea urchins are called *scavengers* because they feed on decaying matter. But they also eat seaweed and living animals found on rocks and the sea bottom. The sea urchin's mouth is in the center of its lower surface. The animal chews with its five sharp teeth. Body wastes and eggs leave the animal through openings in the center of its upper surface. Sea urchins move by the pushing action of their spines and tiny *tube feet,* which have sucking disks. The tube feet are pushed out through small holes in the test. Some sea urchins can dig holes into rock with their teeth, or by rotating their spines.

Scientific Classification. Sea urchins belong to the sea urchin class, *Echinoidea* of the phylum *Echinodermata.*

ROBERT D. BARNES

SEA WALNUT. See CTENOPHORE.

SEA WASP. See JELLYFISH.

SEABEES are members of U.S. Navy construction battalions. The name *Seabees* is taken from the first letter of each word of the official name, Construction Battalion.

Seabees build and repair overseas bases to support Navy and Marine Corps forces. They are also trained to defend what they build. They have built bases from the tropics to the North and South polar regions, and their work includes projects such as airfields and waterfront facilities. Most of the World War II Seabees were experienced carpenters, plumbers, electricians, and engineers who left civilian jobs to join the Seabees. They earned their "Can Do" reputation on such islands as Guadalcanal, Tarawa, and Guam.

The first battalion of Seabees was authorized on Jan. 5, 1942. Since World War II, the Seabees have been made a permanent part of the U.S. Navy. E. J. PELTIER

SEABORG, GLENN THEODORE (1912-), is one of the American scientists responsible for the development of the atomic bomb. He shared the 1951 Nobel prize for chemistry with Edwin M. McMillan for the discovery of artificial elements heavier than uranium. Seaborg is a discoverer of elements 94 through 98, and of element 101 of the periodic table. These are *plutonium, americium, curium, berkelium, californium,* and *mendelevium.* Seaborg and his co-workers produced these elements in the cyclotron at the University of California at Berkeley. Seaborg also discovered many radioactive isotopes used in medical therapy and in biological and chemical research.

Seaborg obtained his Ph.D. degree in 1937 from the University of California. He joined the Manhattan Project in 1942, and worked out on a minute scale the process for separating plutonium from uranium. This process was magnified 10 billion times to produce enough plutonium for the first atomic bomb. Seaborg was chancellor of the University of California from 1958 until 1961, when President John F. Kennedy appointed him chairman of the Atomic Energy Commission. Seaborg served in that position until 1971. He was born in Ishpeming, Mich. HERBERT S. RHINESMITH

Related Articles in WORLD BOOK include:

Americium	Californium	Manhattan Project
Atomic Energy Commission	Curium	Mendelevium
Berkelium	Element, Chemical (table)	Plutonium

SEABURY, SAMUEL (1729-1796), became the first American Episcopalian bishop in 1784. He served as the first presiding bishop of the Protestant Episcopal Church from 1789 to 1792. Seabury was born at Groton, Conn. He was ordained in 1753. During the American Revolutionary War, his Tory sympathies cost him his position, and he supported his family by practicing medicine and serving as a regimental chaplain in the British Army. EARLE E. CAIRNS

SEAFOOD. See FISH (The Importance of Fish). See also FISHING INDUSTRY with its list of Related Articles.

SEAGREN, BOB. See TRACK AND FIELD (picture).

Steve McCutcheon

Many Northern Fur Seals Spend the Summer on Alaskan Islands, and Travel South for the Winter.

SEAL is a sleek sea animal with a body shaped like a torpedo. Seals are excellent swimmers and spend much time in the water. But they give birth to their young on land. Most kinds of seals live in the oceans or in inland seas, but a few live in fresh water. The Baikal seal, for example, lives in Lake Baykal in southern Russia.

Some kinds of seals, including harbor seals and ringed seals, spend much of their time on land or on floating chunks of ice. But northern fur seals stay at sea for 6 to 8 months. They *migrate* (travel) about 5,000 miles (8,000 kilometers) a year—farther than any other mammal. They swim south from the Bering Sea almost to northern Mexico, and then return north. During the entire trip, the seals swim 10 to 100 miles (16 to 160 kilometers) from the coast and never go ashore. No one knows why the seals make their yearly trip.

The largest seal is the southern elephant seal, which lives in the sub-Antarctic waters off South America. The male may grow to be 21 feet (6.4 meters) long and may weigh up to 8,000 pounds (3,600 kilograms). This seal ranks second in size only to whales among all sea mammals. The smallest seal is the ringed seal of the Arctic. It is about $4\frac{1}{2}$ feet (1.4 meters) long and weighs up to 200 pounds (91 kilograms).

Karl W. Kenyon, the contributor of this article, is a biologist for the Bureau of Sport Fisheries and Wildlife in the U.S. Fish and Wildlife Service.

Men hunt some kinds of seals chiefly for their soft, silky fur. The fur wears well and makes excellent coats, hats, and trimming for cloth coats. The yearly U.S. catch of northern fur seals is worth about $\$3\frac{1}{2}$ million. After the fur has been removed, the seal meat may be frozen and sold as animal food. The meat also can be ground into meal for use as fertilizer or poultry feed.

Some Eskimos and other Alaskans eat seal meat. The meat has such a strong flavor that most people in other parts of the world do not like it. Seal blubber is used for cooking, or is burned for light and heat. Eskimos also make hunting clothes from the skins of ringed seals,

FACTS IN BRIEF

Names: *male*, bull; *female*, cow; *young*, calf, pup, or whelp; *group*, herd or pod.

Gestation Period: About 8 to 12 months, depending on the species.

Number of Newborn: Usually 1, rarely 2.

Length of Life: 40 years or more.

Where Found: Along the coasts of continents in most parts of the world; a few kinds in fresh-water lakes and inland seas.

Scientific Classification: Seals make up the pinniped order, *Pinnipedia*. Fur seals and sea lions belong to the eared seal family, *Otariidae*. Walruses belong to the walrus family, *Odobenidae*. Elephant seals and harbor seals belong to the earless seal family, *Phocidae*.

and use walrus hides to cover the wooden frames of their boats. They stretch the intestines of seals and sew them together in strips to make raincoats.

Seals make up a group of mammals called *Pinnipedia*. This name comes from Latin words meaning *fin-footed*. A seal's flippers look somewhat like fins.

There are three main groups of pinnipeds: (1) eared seals, which include fur seals and sea lions; (2) earless seals, including harbor seals and elephant seals; and (3) walruses. An earless seal has small ear openings, but no ears on the outside of its body. Walruses also have small ear openings but no outside ears. They are the only pinnipeds with tusks.

The Body of a Seal

Most kinds of seals have hair on their bodies, but some adult male walruses are almost hairless. Fur seals have thick coats of fine hair. Like all other mammals with fur, seals shed their coats every year and grow new ones. Most species of seals shed a few hairs at a time, much as cats and dogs do. But elephant seals lose large pieces of skin and hair and look ragged.

All seals have a layer of blubber 1 to 6 inches (2.5 to 15 centimeters) thick. It helps keep the animals warm, and gives them energy when they can get no food.

Head. Some kinds of seals have small heads with short noses that give their faces a "pushed in" appearance. An elephant seal has a long, curved nose. The male hooded seal's nose joins a pouch that extends over the top of its head. When the animal is annoyed, it blows air into the pouch. The outer skin of the nose and pouch expands like a balloon, and forms a bright red hood on the animal's head. The seal uses its hood to frighten enemies. All seals have slitlike nostrils, which they close when they dive or swim under water.

The eyes of most species of seals are large and shiny, but walruses have small eyes. Most seals can see and hear well, but they have a poor sense of smell.

Flippers. Seals have four legs, but the leg bones above the ankles are buried inside the body. The parts that extend outside, including the feet, form the animal's large, paddlelike flippers. The front flippers of fur seals and sea lions are longer and flatter than those of other species. A fur seal's front flippers may be more than $1\frac{1}{2}$ feet (46 centimeters) long and 6 inches (15 centimeters) wide, and help make this animal a powerful swimmer. The front flippers of earless seals are smaller and narrower than those of fur seals. Earless seals swim by moving their bodies and rear flippers much as fish move their bodies and tails. A frightened fur seal can swim as fast as 10 miles (16 kilometers) per hour for about five minutes, but then it tires and slows down.

Fur seals, sea lions, and walruses turn their rear flippers forward and downward to help support their bodies on land. They walk on all four flippers. The rear flippers of earless seals extend straight back, palm to palm. These seals cannot turn their flippers forward. They pull themselves across land or ice by contracting their strong belly muscles.

The Life of a Seal

Most kinds of seals live in groups and may stay together on long ocean journeys. A few species, including the Ross seals of the Antarctic, live alone or with only two or three other seals. Some species, including grey seals and ringed seals, have lived 40 years or more.

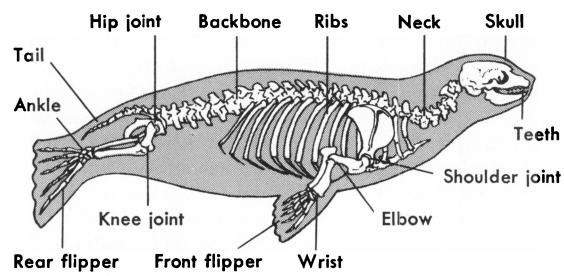
Seal Rookeries. Every spring, seals go to their breeding grounds, called *rookeries*, to have young and to find mates. Most rookeries are on islands. Rookeries of northern fur seals are large beach areas, and more than 150,000 seals may gather at one rookery.

The northern fur seal *bulls* (males) are the first to arrive at the rookeries. Late in May their bellows and roars can be heard over 1 mile (1.6 kilometers) away as they fight for their choice of places, called *territories*, along the beach. The *cows* (females) come ashore in early July and join the *harem* (group of females) of one of the bulls. A bull's harem consists of 3 to more than 40 cows, and a few bulls may have over 100 cows. Shortly after a cow arrives on shore, she gives birth to the baby she has carried inside her body for about 12 months. The cow mates again a few days after giving birth.

Bull seals fight to get their territories and to protect them, but they do not fight to get cows. Bulls are not strong enough to hold a territory until they are about 10 years old. The young bachelors, and older bulls without harems, live apart from the others. Most cow seals bear their first young when they are about 5 years old, and may give birth each year until they are 13. Some cow seals may bear young until they are 20 or older.

Young. A female seal almost always has one *pup* (baby seal) at a time. Twins are rare. A newborn pup has all its teeth, and fine, soft fur covers its body. Sea lion pups have brown fur, and newborn fur seals, elephant seals, and monk seals have black coats. The

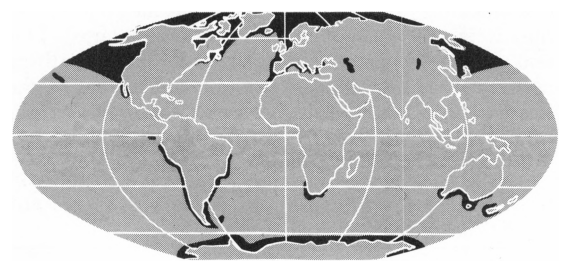
THE SKELETON OF A SEAL

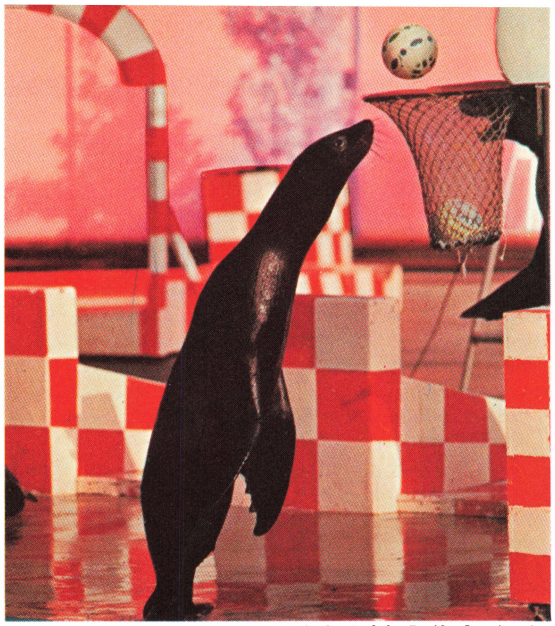


WORLD BOOK illustration by Tom Dolan

WHERE SEALS LIVE

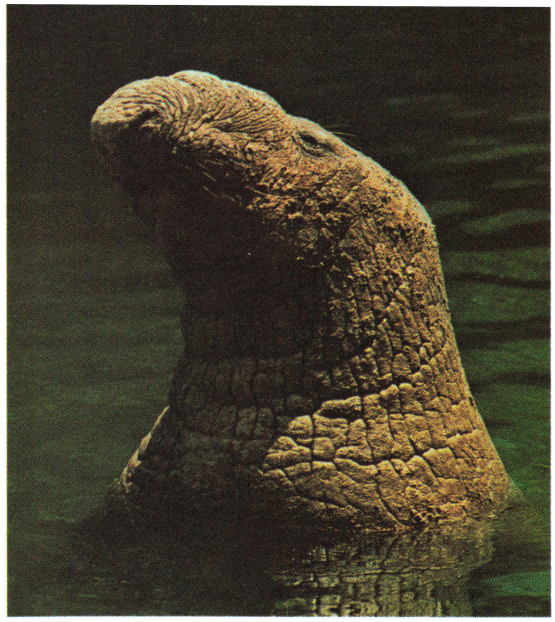
The black areas of the map show the parts of the world where seals are found. Most seals live in the Northern Hemisphere.





Marineland of the Pacific, Los Angeles

A California Sea Lion stands on its rear flippers and uses its nose to shoot a ball into the basket. These seals learn tricks easily and are star performers in many zoos and circuses.



Cy La Tour

The Elephant Seal, also called the *sea elephant,* is named for its large nose, which grows about 15 inches (38 centimeters) long. The tough skin also looks somewhat like elephant hide.

pups of harp seals, leopard seals, walruses, and other seals that live on floating islands of ice may be white, grayish, or brown.

Northern fur seal pups can swim and can travel on land as soon as they are born. The mothers divide their time between eating at sea and nursing their pups on land. A mother may stay at sea from seven to nine days. After she returns, she hunts for her pup among the hundreds of others on the beach. Each mother feeds only her own pup, which she recognizes by its cry and its odor. The pup gets enough milk to stay alive until its next feeding. Seal milk is rich, and the pups grow quickly. A fur seal weighs about 10 pounds (4.5 kilograms) at birth and from 30 to 35 pounds (14 to 16 kilograms) when its mother leaves it, 3 or 4 months later.

Food. Seals eat fish, sea birds, and squids. Leopard seals and walruses sometimes eat other seals. Crabeater seals, which live on floating ice in the Antarctic, do not eat crabs. Their food consists of shrimp and small fish.

A seal has sharp, pointed teeth. It cannot chew food because its teeth do not have flat surfaces. Seals grasp and tear most of their prey, but they swallow small fish whole, head first. Walruses are the only seals with tusks. They probably use their tusks somewhat like skis to skid along the ocean bottom. A walrus uses its tongue like a vacuum tube to eat clams, its favorite food.

Enemies. The seal's greatest enemy is man. For hundreds of years, hunters have killed seals for blubber, bones, fur, and meat. During the 1800's, so many seals were killed that only a few survived. Several nations, including the United States, quarreled about how northern fur seals should be hunted. In 1911, they agreed to limit the hunting. In 1957, Canada, Japan, Russia, and the United States signed a treaty to protect seals.

The number of seals has increased because of careful international management of seal hunting. In 1911, there were only about 150,000 northern fur seals on the Pribilof Islands. Today, there are about 1½ million. The yearly harvest of skins averages about 60,000. Under the treaty, seals are hunted commercially only on land. Canada and Japan do not hunt seals because none of the rookeries are in their territory. The Soviet Union and the United States each give 15 per cent of their catch to Canada and 15 per cent to Japan. In this way, the seal catch is shared by all the nations in whose territory the animals live.

All U.S. sealing is done by men employed by the federal government. The sealskins are given to private firms for processing and selling, and the money goes into the U.S. Treasury. Alaska gets 70 per cent of the money under the terms of its statehood act. Congress gives some of the rest to the National Marine Fisheries Service, which manages the fur seal industry.

Seals have few enemies beside man. Large sharks and killer whales attack them in the water, and polar bears hunt seals on ice. A seal has few defenses against its enemies. In the water, it usually tries to escape an attacker. Some species swim swiftly and easily among the strong waves and between the large rocks close to shore where most of their enemies cannot follow. Other species take deep dives when an enemy approaches. A Weddell seal of the Antarctic can dive as deep as 2,360 feet (719 meters). It can stay underwater as long as 43 minutes before surfacing to breathe.

Many kinds of seals are so slow and clumsy on land or ice that they have little chance of escaping an enemy. The crabeater is one of the fastest seals on land or ice. It can move about 15 miles (24 kilometers) per hour—almost as fast as a man can run.

KARL W. KENYON

Related Articles in WORLD BOOK include:

Alaska (Natural Resources; Wildlife Products)
Animal (color picture: Animals and Their Young)
Antarctica (Seals and Whales)
Bering Sea Controversy
Eskimo
Fur
Pribilof Islands
Walrus

SEAL is a device with a design or lettering for *impressing* (stamping) on paper, wax, or metal. Seals are often attached to official and important documents to prove that they are trustworthy. Every country in the world and many cities, states, provinces, important officials, and commercial enterprises have seals.

The *matrix* (mold) of a seal may be made of paper, metal, or gem. It may consist of two pieces, the *baso* (bottom) and *alto* (top). The matrix is used for stamping one design on paper. It can also be used to stamp different designs on the *obverse* (front) and the *reverse* (back) of wax or lead. In early times, kings and other officials wore signet rings. They pressed the design of the ring on hot wax to make a seal. ARTHUR E. DUBOIS

For a description and color picture of each state seal in the United States, see each state article. See also BABYLONIA (Art); GREAT SEAL OF THE UNITED STATES; NAPOLEON I (picture); PRIVY SEAL; SEALING WAX.

SEALING WAX is used for sealing letters and documents and for taking the impression of seals (see SEAL [a design or lettering]). The wax may be made of rosin, shellac, turpentine, magnesia, chalk, or gypsum. Wax also may be used for sealing bottles and jars.

Before envelopes with gummed flaps were invented, sealing wax was used to seal letters. Wax used for letters and documents is colored with vermilion, a red coloring matter. It is sold in a stick form. An inferior grade of sealing wax used for sealing packages is usually colored with lampblack. An inexpensive wax for sealing fruit bottles and jars may be made by mixing nine parts of rosin with one part beeswax, and heating the mixture until it melts. The necks of the bottles should be dipped in the melted wax. GEORGE R. GREENBANK

SEALYHAM TERRIER is a strong, short-legged dog. It is a good rat catcher, and can be trained to pull animals such as the fox and otter out of burrows. The Sealyham stands 10 inches (25 centimeters) high, and weighs about 20 pounds (9 kilograms). It has a long head, powerful jaws, and a blunt, heavy muzzle. Its wiry coat is white, with brownish patches on the head. It was first bred at Sealyham, Wales, about 1850. See also DOG (color picture: Terriers). JOSEPHINE Z. RINE

SEAM. See COAL (Coal Beds); SEWING.

SEAMAN, ELIZABETH COCHRANE. See BLY, NELLIE.

SEAMANSHIP. See SHIP (A Ship at Sea).

SÉANCE. See SPIRITUALISTS; MESMER, FRANZ.

SEAPLANE. See AIRPLANE (Airplanes of Today).

SEAPORT. See HARBOR; PORT.

SEARCH, RIGHT OF. See RIGHT OF SEARCH.

SEARCH WARRANT is a paper issued by a court, which permits a law officer to search a house or other building. It is issued if there is reasonable cause to believe that illegal equipment, such as gambling devices, burglar tools, or counterfeiting machinery, is hidden there. A search warrant may also be issued to search for persons. In the United States Constitution, Amendment 4 states that no unreasonable searches or seizures may be made. The cause of search must be supported by oath. The warrant must describe the place to be searched, and what is to be seized in the search.

Before 1760, search warrants in England and America were issued only for concealed stolen goods. In England, searches and seizures became so great an issue, and were finally so restricted, that it led to the saying that "every man's home is his castle." FRED E. INBAU

SEARCHLIGHT. See FIRE FIGHTING (picture).

SEARLES LAKE. See MOJAVE.

SEARS, PAUL BIGELOW (1891-), an American botanist, became an authority on pollens, applied ecology, and the history of climate. He taught at the University of Nebraska, the University of Oklahoma, and Oberlin College. Sears became chairman of the Yale University conservation program, and wrote *Deserts on the March* (1935), *Life and Environment* (1939), *This Is Our World* (1939), and *This Useful World* (1941). He was born at Bucyrus, Ohio. ROGERS MCVAUGH

SEARS, ROEBUCK AND COMPANY. See MAIL-ORDER BUSINESS.

SEASHORE is the place where the land and the sea meet. It is an area of continual change. As the sea rolls in at high tide, much of the shore becomes part of the ocean. At low tide, the sea retreats and the same area again becomes part of the land. But in spite of this ever-changing environment, the seashore supports a great variety of animals and plants. Many of these organisms live nowhere except along the ocean's edge.

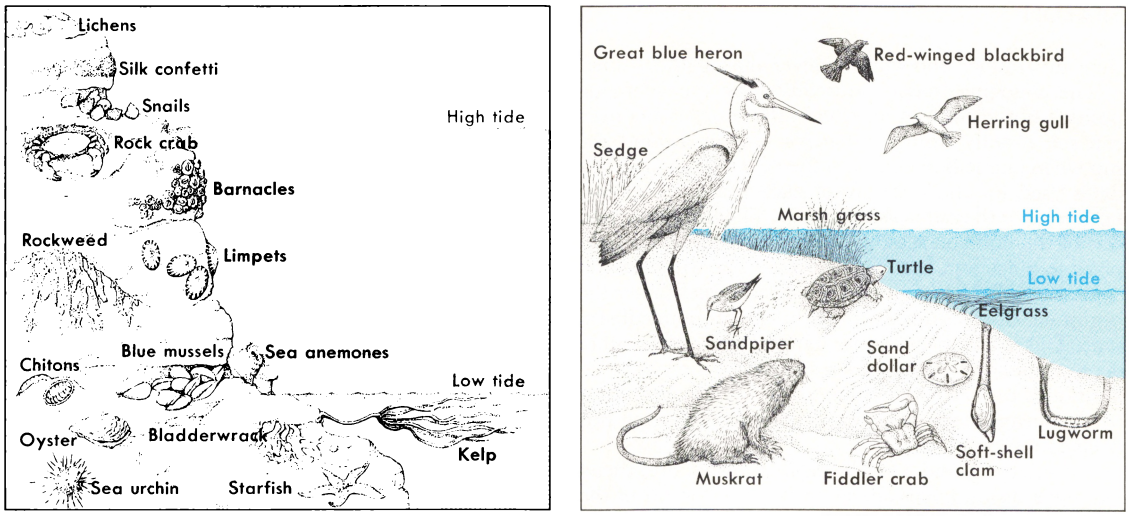
Various tiny animals and plants, called *plankton*, play an important role in the life of the seashore. These organisms swim or float on the ocean tide. Many of them remain part of the plankton for their entire life, but others grow into larger animals and plants of the seashore. For example, many seaweeds begin their life as *spores*, one-celled floating members of the plankton. Most large seashore animals start their existence as *larvae*, plankton creatures that bear little resemblance to their parents. Most spores and larvae die, but some land on a suitable shore and grow into adults.

Plankton serves as more than a nursery for seashore life. As the waves of the ocean sweep across the shore, they carry with them a feast of plankton. Many seashore animals feed on these tiny organisms. Such creatures as barnacles, mussels, oysters, and sponges spend their adult life permanently attached to the shore. They eat the plankton when it comes to them. Other animals, including clams and worms, burrow into the shore and collect their food from the water containing plankton. Even the various shorebirds that feed on the plankton-eating creatures rely indirectly on the plankton.

Scientists classify seashores into three main types, depending on their surface: (1) rocky shores, including coral reefs; (2) muddy shores; and (3) sandy shores. Characteristic groups of animals and plants live on each type of shore.

Life on Rocky Shores is more plentiful than on any other type of seashore. Great numbers of animals and plants crowd the hard, rough surfaces of coral reefs and wave-scarred cliffs. These organisms must withstand powerful waves that could wash them away or smash them on the rocks.

Most organisms of rocky seashores have special features that hold them securely to the rocks and coral. Many adult animals, including barnacles, mussels, oysters, sea squirts, and sponges, permanently anchor themselves to the shore. Others, such as chitons, limpets, sea anemones, sea urchins, and starfish, also attach themselves firmly to the shore, but they are capable of moving short distances. Some animals, including plantlike



WORLD BOOK illustration by Marion Pahl

A Variety of Animals and Plants Live Along the Seashore. Most of those found on rocky coasts, *left*, have special features that enable them to cling tightly to the shore. In this way, they avoid being washed away or broken on the rocks by waves. Most of the animals of muddy shores, *right*, burrow into the soft ground to escape the waves. At low tide, a number of species of birds and mammals visit muddy shores to feed on the burrowing creatures.

bryozoans and *hydroids*, have flexible bodies that bend with the motion of the waves. Large seaweeds, such as *kelps* and *rockweeds*, cling to the shore with structures called *holdfasts*. Many species of worms and other creatures burrow into the rock and coral, and others jam themselves tightly into cracks.

Most animals that live on rocky shores eat plankton. A few, including rock crabs and starfish, feed on the creatures that eat the plankton. The plants of rocky shores, even the seaweeds, are simple organisms called *algae*. Algae, like most kinds of plants, create their own food. But unlike most plants that grow on land, algae have no leaves, roots, or stems.

Life on Muddy Shores. Most muddy seashores lie in bays, protected from strong waves. Rivers empty into many such bays, decreasing the saltiness of the sea water. Land plants—including various grasses and, in the tropics, mangrove trees—thrive along muddy shores. Crabs and turtles live among these plants. Clams and various worms burrow into the muddy bottom.

Life on Sandy Shores. Sandy beaches have fewer forms of life than do rocky or muddy shores. Most plants and animals cannot attach themselves strongly enough in the loose sand to withstand waves and currents. Most of the animals of sandy shores—including clams, ghost crabs, mole crabs, and sand dollars—burrow under the sand. Few plants live on sandy shores between the levels of high and low tide. CADET HAND

See also OCEAN (Life in the Ocean; The Changing Shoreline).

SEASHORE, CARL EMIL (1866-1949), an American psychologist, became known for his studies of musical ability. He pioneered in the scientific testing of hearing, and his measures of musical ability have been widely used in guiding and selecting students in music. He was born at Mörlunda, near Oskarshamn, Sweden.

SEASICKNESS is a disagreeable illness that comes from the pitching and rolling of a ship at sea. The symptoms include dizziness and headache, nausea, a sinking feeling in the stomach, and vomiting. In a severe attack, the skin becomes pale, almost green, and damp, the pulse is feeble, and the person feels exhausted.

Doctors have given several different explanations of seasickness. The one most widely accepted says that the ailment is caused by disturbance in the semicircular canals of the inner ear. These canals give a person his sense of equilibrium. Some persons get the illness by swaying in a hammock, or from traveling by airplane.

Persons who become seasick easily can make the attacks less severe. On a rough sea, a person can help overcome his nausea by lying quietly, with his eyes closed.

But if the attack continues, the ship's doctor should take charge of the case, to see that the patient does not suffer a collapse. Drugs such as hyoscine and Dramamine help prevent and treat seasickness. They are usually effective with most people. PAUL R. CANNON

See also AIRSICKNESS; DRAMAMINE.

SEASON is one of the four periods of the year. Each season—spring, summer, autumn, and winter—lasts about three months and brings changes in temperature, weather, and the length of daylight.

During the spring, the days are warm in middle parts of the Northern Hemisphere, the northern half of the earth. Summer follows with hot days and warm nights. In autumn, the days become cooler, leading to the cold of winter. The four periods are called *climatic seasons* when based on these temperature and weather changes.

In the Southern Hemisphere, the climatic seasons differ by about six months. This hemisphere has summer when the Northern Hemisphere has winter.

Some regions do not have all four climatic seasons. In parts of the tropics, for example, temperatures change little. But the amount of rainfall varies greatly, so that these regions have a wet season and a dry season. The polar regions, on the other hand, have a light season and a dark season. There, the sun shines almost all the

time in summer and almost never during the winter.

The changing seasons are caused by the changing position of the earth in relation to the sun. Astronomers can tell exactly from the earth's motion around the sun when one season ends and the next one begins. The dates used for the first day of each season mark the beginning of the *astronomical seasons*. The beginning and end of the climatic seasons vary from these dates from place to place and from year to year. The warmest and coldest weather generally occurs several weeks after the beginning of the summer and winter astronomical seasons. This is true because the temperature and weather do not change instantly in response to the changing position of the earth in relation to the sun. Heat retained by the oceans plays an important role in producing this delayed response.

The relative position of the earth and sun, and therefore the seasons, keeps changing because the tilt of the earth's axis never changes while the earth circles the sun. One way to understand this is to picture which way the tilt of the axis causes the North Pole to slant at different times of the year. When the North Pole slants toward the sun, the Northern Hemisphere receives the most sunlight and it is summer there. When the pole slants away from the sun, the Northern Hemisphere receives the least sunlight and it is winter. Spring begins when the pole starts to slant toward the sun, and autumn begins when the pole starts to slant away again.

Summer begins in the Northern Hemisphere when the *summer solstice* occurs, on June 20 or 21. The sun is high in the sky and there are more hours of daylight than on any other day. The *winter solstice* marks the beginning of winter in the Northern Hemisphere. It occurs on December 21 or 22. The sun is low in the sky and there are fewer daylight hours than on any other day.

The *vernal equinox* marks the beginning of spring, on March 20 or 21. Autumn begins on September 22 or 23, the *autumnal equinox*. At both points, the sun appears directly above the equator. During each equinox, places on the earth have approximately 12 hours of daylight and 12 hours of darkness.

JOHN E. KUTZBACH

FIRST DAY OF THE ASTRONOMICAL SEASONS IN THE NORTHERN HEMISPHERE*

Year	Spring	Summer	Autumn	Winter
1971	March 21	June 21	Sept. 23	Dec. 22
1972	March 20	June 21	Sept. 22	Dec. 21
1973	March 20	June 21	Sept. 22	Dec. 21
1974	March 20	June 21	Sept. 23	Dec. 21
1975	March 20	June 21	Sept. 23	Dec. 22
1976	March 20	June 21	Sept. 22	Dec. 21
1977	March 20	June 21	Sept. 22	Dec. 21
1978	March 20	June 21	Sept. 23	Dec. 21
1979	March 20	June 21	Sept. 23	Dec. 22
1980	March 20	June 20	Sept. 22	Dec. 21
1981	March 20	June 21	Sept. 22	Dec. 21
1982	March 20	June 21	Sept. 23	Dec. 21
1983	March 20	June 21	Sept. 23	Dec. 22
1984	March 20	June 20	Sept. 22	Dec. 21
1985	March 20	June 21	Sept. 22	Dec. 21

*Central Standard Time

Related Articles in WORLD BOOK include:

Autumn	Equinox	Solstice	Summer
Calendar	Indian Summer	Spring	Winter

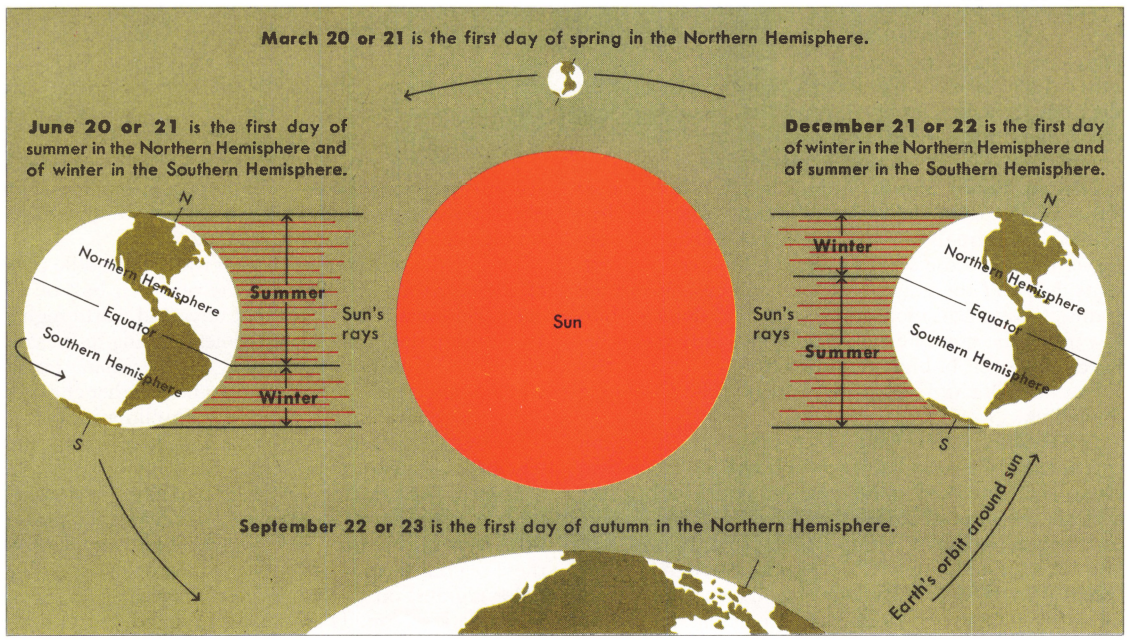
SEASONING. See COOKING; SPICE.

SEATO. See SOUTHEAST ASIA TREATY ORGANIZATION.

The Change of Seasons

The seasons change because places on the earth receive different amounts of sunlight during the year. The tilt of the earth's axis produces the differing amounts of sunlight. When the North Pole is tilted toward the sun, the Northern Hemisphere has summer. The sun's rays strike the earth from a high angle and each place receives maximum sunlight. When the North Pole is tilted away from the sun, the Northern Hemisphere has winter. The sun's rays come from a lower angle and each place receives minimum sunlight. As the earth moves between its summer and winter positions, autumn and spring occur.

WORLD BOOK diagram



Dudley, Hardin & Yang, Inc.

Seattle Landmarks include the Space Needle and nearby Mount Rainier. The Space Needle, *center,* was built for the 1962 Century 21 Exposition. It stands 607 feet (185 meters) high.

SEATTLE is the largest city in Washington and an important manufacturing, trade, and transportation center of the Pacific Northwest. The city lies on the east shore of Puget Sound, about 125 miles (201 kilometers) from the Pacific Ocean via the Strait of Juan de Fuca. Seattle's location has helped make it a gateway to Alaska and the Far East. About two-fifths of the state's people live in the Seattle metropolitan area.

In 1851, pioneers from Illinois founded a settlement along Puget Sound on Alki Point. They chose this site because of the area's many natural resources, including plentiful timber and water. The next year, they moved the settlement inland to the shores of Elliott Bay. They named their town Seattle for Chief Sealth, a Duwamish Indian who had befriended them.

The cutting and shipping of lumber accounted for much of the city's early economic development. But by World War II (1939-1945), aircraft manufacturing had become Seattle's chief source of income. Aircraft sales began to decline during the late 1960's, and thousands of workers lost their jobs. Today, Seattle is struggling to recover from this economic setback.

The City. Seattle covers 92 square miles (238 square kilometers). It is bordered by Puget Sound on the west and Lake Washington on the east. The Hiram M. Chittenden Locks, Lake Union, and the Lake Washington Ship Canal connect the sound with Lake Washington. The Seattle metropolitan area occupies 4,318 square miles (11,184 square kilometers) and covers King and Snohomish counties. The Olympic Mountains rise west of the city. To its east is the Cascade Mountain Range. It includes Mount Rainer, which stands 14,410 feet (4,392 meters) high.

The city is built on many hills. These hills once hindered the flow of traffic. By using water under great pressure, the city washed some sections of the hills into Elliott Bay, which is located on Puget Sound. This operation extended the shoreline and created new ground for an industrial area.

FACTS IN BRIEF

Population: 530,831. *Metropolitan Area Population*—1,424,-605.

Area: 92 sq. mi. (238 km²). *Metropolitan Area*—4,318 sq. mi. (11,184 km²).

Altitude: 510 ft. (155 m) above sea level.

Climate: *Average Temperature*—January, 41° F. (5° C); July, 66° F. (19° C). *Average Annual Precipitation* (rainfall, melted snow, and other forms of moisture)—34 in. (86 cm). For the monthly weather in Seattle, see WASHINGTON (Climate).

Government: Mayor-council. *Terms*—4 years for the mayor and 9 councilmen.

Founded: 1851. Incorporated as a city in 1869.

Seattle's central business district extends eastward from the bay. The 50-story First National Bank Building rises above the area. Pike Place Market, west of the main shopping area, has art galleries, restaurants, and open-air shops. The Seattle Center, north of the business district, includes buildings from the Century 21 Exposition, a world's fair held in 1962. One of them is the Space Needle, an observation tower and restaurant 607 feet (185 meters) high. A monorail railroad links the center with downtown Seattle.

Bridges connect central Seattle with residential areas on the east side of Lake Washington. These suburbs include Bellevue, Kirkland, and Mercer Island. Auburn, Kent, and Renton lie to the south.

The People. About 85 per cent of Seattle's people were born in the United States, and about 15 per cent have Scandinavian ancestry. Negroes and other minority groups, including American Indians and Orientals, make up about 12 per cent of the population. Most of the minority groups live in the city's central and southern sections, where poverty is a problem. The federal Model Cities program has worked to improve conditions there.

Methodists and Roman Catholics form the two largest religious groups in Seattle. Other major denominations include Episcopalians, Lutherans, and Presbyterians.

Economy. Waterways in Washington provide a valuable source of electric power for Seattle's industry, and manufacturing provides most of the city's income. The Boeing Company, one of the largest U.S. aircraft producers, has more employees than any of the other 2,200 manufacturers in the area. In mid-1968, about 100,000 persons worked for Boeing. But a decline in the sale of commercial airplanes began that year. It forced the firm to lay off about 65,000 employees between late 1968 and 1971. Employment in another major industry, lumbering, also declined during the late 1960's because of a slowdown in housing construction. To combat unemployment, the Seattle Area Industrial

CITY OF SEATTLE

Seattle is the largest city in the Pacific Northwest. The map at the right shows important points of interest in the city. The map below shows other communities in the area.

City boundary
County boundary
Main road
Other road
Point of interest
Built-up area
Nonbuilt-up area
Park
Military area

Seattle Geographical Area

WORLD BOOK map

Council started a campaign to attract new businesses. Other manufacturing industries produce cement, clay, fishing supplies, flour, metal products, and textiles.

The Port of Seattle handles about 15 million short tons (14 million metric tons) of cargo yearly. Seattle has become the principal supplier of food products to Alaska and a major importer and distributor of Alaskan canned salmon. Seattle has a large fishing fleet and is famous for its halibut catch.

Twelve major airlines use the Seattle-Tacoma International Airport. The National Railroad Passenger Corporation (Amtrak) operates passenger trains to and from Seattle. Three local transit systems serve the area.

Seattle has two daily newspapers, the *Post-Intelligence* and the *Times*. Four television stations and about 20 radio stations broadcast from the city.

Education. The Seattle public school system includes about 115 elementary and high schools with a total of approximately 85,000 students. Negroes make up about 13 per cent of the enrollment. In many neighborhoods, the Seattle School Board faces the problem of racially segregated schools. The board began a voluntary busing program in 1963. This program calls for white students to be bused to schools in black neighborhoods, and black students to schools in white neighborhoods. But the program failed to end segregation because few parents have allowed their children to change schools.

The school board also faces another major problem. Every year, it must seek voter approval of a special levy to raise about a third of the money it needs to pay its costs. As a result, controversies arise over expenses, and important programs are delayed or canceled.

About 25,000 students attend 85 parochial and private schools in Seattle. Many Roman Catholic schools lack funds to cover operating costs. A few have been forced to close or to merge with other schools.

The University of Washington, the largest university in the Pacific Northwest, is in Seattle. It has an enrollment of more than 33,000. Other institutions of higher learning in the city include Seattle Pacific College and Seattle University. The Seattle Public Library owns more than 1½ million books and operates 15 branches.

Cultural Life. The Seattle Symphony, the Youth Symphony, and the Seattle Opera Association perform in the Opera House of the Seattle Center. Visiting ballet companies, orchestras, and other groups also use the Opera House. Next to it is the Playhouse, the home of the Seattle Repertory Theater. Another drama group, A Contemporary Theatre (ACT), has a playhouse near the downtown area.

The Seattle Art Museum features a famous collection of Oriental works. The Henry Art Gallery, on the University of Washington campus, displays modern art. The Museum of History and Industry and the Pacific Science Center are also in Seattle.

Recreation. Seattle's park system covers over 3,800 acres (1,540 hectares) and includes about 140 parks and playgrounds. Woodland Park, which covers 188 acres (76 hectares), has an amusement area, gardens, and a zoo with more than 1,800 animals. The 130-acre (53-hectare) Lincoln Park includes picnic grounds, gardens, and lawns. The conservatory in Volunteer Park features rare plants.

Doug Wilson, Black Star

The Port of Seattle extends along Elliott Bay, near Puget Sound. It serves over 50 steamship lines and is a major port for goods shipped between the United States and the Far East.

During the summer, many people enjoy boating, fishing, and swimming in Puget Sound and the area's inland lakes. In winter, the mountains attract thousands of skiers. The Seattle SuperSonics of the National Basketball Association play in the Coliseum in the Seattle Center.

Government. Seattle has a mayor-council form of government. The voters elect the mayor and the nine members of the city council to four-year terms. Sources of city income include a business and occupation tax, property taxes, and a share of the state sales tax.

Seattle's public bus and trolley system has become one of the city government's major problems. A decreasing number of patrons has resulted in a shortage of funds to operate the system. To attract more riders, officials proposed a plan for a new rapid transit system. But the voters rejected the plan in 1970. Proposals to modernize the present facilities were then introduced.

History. Many Indian tribes, including the Duwamish, the Snohomish, and the Suquamish, once hunted and fished in what is now the Seattle area. In 1851, a group of Illinois pioneers led by Arthur A. Denny settled at Alki Point on Puget Sound. In 1852, they moved to the shores of Elliott Bay and established the town of Seattle. Henry Yesler built a sawmill there in 1853, and lumbering soon became Seattle's chief industry.

During the 1860's, Seattle grew steadily. Coal mines opened in the area, and trading ships began to anchor in Elliott Bay. Seattle received a city charter in 1869, and the population reached about 1,000 the next year.

In 1875, regular steamship service began between Seattle and San Francisco. A railroad linked Seattle

University of Washington

The University of Washington lies partly along Portage Bay, *top*, in northern Seattle. The university, established in 1861, is the oldest state-supported university on the Pacific Coast.

with coal fields in nearby Newcastle in 1877. In 1884, Seattle became a terminal of the Northern Pacific Railroad. Fire destroyed the city's business section in 1889. In spite of this setback, the population climbed to 42,000 by 1890.

In 1897, the steamship *Portland* docked in Seattle Harbor with $800,000 worth of gold from the Yukon region of Canada. Prospectors flocked to the city to buy supplies and to board ships sailing for the Yukon and gold-mining areas in Alaska. Old industries expanded and new ones began. By 1900, about 80,000 persons lived in Seattle, and by 1910, the population had climbed to about 237,000.

Seattle grew steadily during the early 1900's. The 1909 Alaska-Yukon-Pacific Exposition, on the shores of Lake Washington, drew more than $3\frac{1}{2}$ million visitors. The opening of the Panama Canal in 1914, linking Seattle with Atlantic ports, and the completion of the Lake Washington Ship Canal in 1917 helped increase trade. In 1916, William Boeing started an aircraft company that grew into Seattle's largest firm.

After the United States entered World War I in 1917, Seattle produced defense materials. The aircraft, lumber, and shipping industries flourished, and workers flocked to the city.

Many defense industries shut down after the war ended in 1918. Thousands of workers lost their jobs, and others received sharp cuts in pay. In protest, more than 60,000 workers staged a five-day general strike in February, 1919. This was the nation's first general strike. Negotiations led to a settlement of the dispute.

Seattle thrived during World War II. The aircraft industry boomed, and several shipbuilding companies were established. The industrial surge, which attracted many blacks to the city, helped the population rise from 368,000 in 1940 to more than 467,000 in 1950.

During the 1950's and 1960's, a large number of families moved from Seattle to the suburbs. As a result, the city's population decreased between 1960 and 1970, but the population of the metropolitan area increased.

In 1962, the Century 21 Exposition helped promote tourism in Seattle. The fairgrounds and buildings are still a year-round civic and tourist center. In 1968, voters in the Seattle area approved a $333-million improvement program, including plans for the expansion of park facilities.

A sharp decrease in aircraft sales during the late 1960's and early 1970's hurt the city's economy. In 1971, Seattle's unemployment rate—about 13 per cent—was higher than that of any other U.S. city.

Civic plans include construction of the domed King County Stadium in downtown Seattle. The stadium was scheduled for completion in 1976. HENRY MACLEOD

See also BRIDGE (picture: Pontoon Bridge); DIABLO DAM; PUGET SOUND; ROSS DAM; WASHINGTON (pictures).

SEATTLE PACIFIC COLLEGE is a liberal arts school in Seattle, Wash. It is controlled by the Free Methodist Church, but admits students of all faiths. It has a graduate school and schools of education, music, nursing, and religion. The college was founded in 1891. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SEATTLE UNIVERSITY is a coeducational school in Seattle, Wash. It is administered by the Roman Catholic Jesuit Fathers, but admits students of all faiths. Bachelor's degrees are offered by the college of arts and sciences; and by the schools of business, education, engineering, and nursing. The college of sister formation conducts courses for women preparing to become nuns. Graduate programs lead to master's degrees. Seattle University was founded in 1891. For the enrollment of Seattle University, see UNIVERSITIES AND COLLEGES (table). JOHN A. FITTERER

SEAWATER, PURIFICATION OF. See WATER (Fresh Water from the Sea).

SEAWEED. Any plant that grows in the sea can be called a seaweed. But when a botanist speaks of seaweed he usually means one of the larger brown or red algae. These seaweeds are relatives of the green pond scums of stagnant water, but not of the higher water plants. The seaweeds of cold waters are chiefly brown algae. Those of the tropics are chiefly red algae.

On Columbus' first voyage to America, his ships passed through masses of seaweed. These weeds were brown algae known as *gulfweeds*. One kind of gulfweed has small air bladders, shaped like berries, and it can float in the water. There is a large mass of these weeds floating in the Atlantic Ocean east of Florida. The area containing these weeds is called the Sargasso Sea.

Giant kelps of the Pacific are another type of brown alga. The "stems" of these giant weeds sometimes grow more than 200 feet (61 meters) long. During World War I, giant kelp were harvested to make fertilizers and explosives. Chemists extract large amounts of iodine and algin from kelps. Algin has many commercial uses because it can hold several different liquids together. In ice cream, it keeps the water in the milk from forming crystals. It is also used in salad dressings, chocolate milk, aspirin, and other foods and drugs.

Irish moss and other red algae contain similar substances as *agar* and *carrageenin*, used in food and drugs.

Scientific Classification. Seaweeds belong to the seven different phyla of algae in the subkingdom *Thallophyta*. The giant kelp and the gulfweed belong to the phylum *Phaeophyta*, or brown algae. The giant kelp is genus *Macrocystis*, species *pyrifera*. The gulfweed is *Sargassum bacciferum*. Irish moss is in the phylum *Rhodophyta*, or red algae. It is *Chondrus crispus*.

LEWIS HANFORD TIFFANY

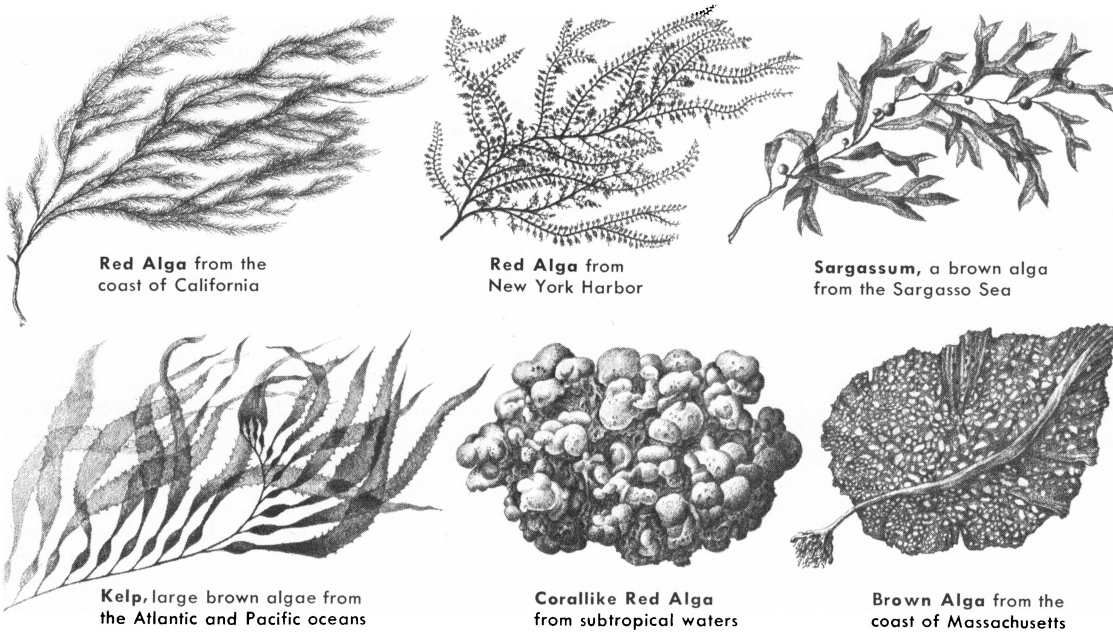
Related Articles in WORLD BOOK include:

Agar	Irish Moss	Sargasso Sea
Algae	Kelp	Water Plant
Harvey, William H.	Ocean (picture)	

Hoffpauir Studio

Boatloads of Giant Kelp Seaweed, a source of the chemical element iodine, dock at the outer harbor in San Pedro, Calif.

SOME TYPES OF SEAWEED



Red Alga from the coast of California

Red Alga from New York Harbor

Sargassum, a brown alga from the Sargasso Sea

Kelp, large brown algae from the Atlantic and Pacific oceans

Corallike Red Alga from subtropical waters

Brown Alga from the coast of Massachusetts

SEBACEOUS GLAND. See SKIN (The Work of the Skin).

SEBASTIAN, *see BAS chuhn,* **SAINT** (died A.D. 288), was one of the early defenders of the Christian faith. He entered the Roman Army without revealing his intent to assist and protect the Christians. The Emperor Diocletian liked him and made him commander of soldiers in Milan. But Sebastian's religious faith was discovered, and he was condemned to death. A troop of soldiers tied him to a tree and shot him with arrows. They thought him dead and left him. He was cared for by a Christian woman named Irene. Sebastian again declared his faith after he recovered. The emperor then ordered him clubbed to death in the amphitheater, and he was buried in the catacombs. Saint Sebastian tied to the tree was a favorite subject of early Italian painters. His feast day is January 20. FULTON J. SHEEN

SEBASTOPOL. See SEVASTOPOL.

SEBORRHEA. See DANDRUFF.

SEC. See SECURITIES AND EXCHANGE COMMISSION.

SECESSION. See CIVIL WAR; NULLIFICATION.

SECHURA DESERT, *say CHOO rah,* is the central portion of the Peruvian Coastal Desert. It covers about 10,000 square miles (26,000 square kilometers). The desert begins roughly at Paita in the north and includes Lima, the capital of Peru, in the south. Almost half the people of the Peruvian Coastal Desert live in the urban centers of the Sechura Desert. G. LANGDON WHITE

SECONAL. See BARBITURATE.

SECOND. See MINUTE.

SECOND CONTINENTAL CONGRESS. See CONTINENTAL CONGRESS.

SECOND EMPIRE. See FRANCE (The Revolutions of 1830 and 1848); NAPOLEON III.

SECOND REPUBLIC. See REVOLUTION OF 1848.

SECOND VATICAN COUNCIL. See VATICAN COUNCIL.

SECONDARY EDUCATION. See EDUCATION (Secondary Education); HIGH SCHOOL; JUNIOR HIGH SCHOOL.

SECORD, *SEE kawrd,* **LAURA INGERSOLL** (1775-1868), was a Canadian heroine of the War of 1812. She risked her life crossing the American lines to warn the British of an American attack in 1813.

Mrs. Secord overheard American troops who were quartered in her Queenstown, Ont., house planning an attack on a British detachment at Beaver Dam in southern Ontario. According to the story, she walked through the American lines, driving a cow ahead of her to avoid suspicion, and warned the British commander. In the battle of Beaver Dam on June 23, 1813, the British surrounded the American force and tricked it into surrendering. The story of Mrs. Secord's courage and ingenuity greatly heartened the Canadian people. She was born in Massachusetts. CLINTON ROSSITER

SECRET BALLOT refers to the right to vote and mark ballots in private. See BALLOT.

SECRET POLICE are used by dictators to control, terrorize, and spy on people. Joseph Fouché, minister of police under Napoleon I, established the modern secret-police system. The political police of the Russian czars was called the *Okhrana.* Since 1917, the Communist leaders in Russia have used the secret police as an important tool for keeping power. This police force has had various names such as OGPU, MVD, and KGB. Hitler developed the German Gestapo to help him keep power. STEFAN T. POSSONY

See also GESTAPO; MVD; POLICE STATE.

SECRET SERVICE, UNITED STATES, is a bureau of the U.S. Department of the Treasury. Its main job is to protect the President, his immediate family, and certain other government officials. The Secret Service also works to stop the counterfeiting of U.S. currency and stamps, and the forgery of government bonds, checks, and securities.

Among the persons protected by the Secret Service are the Vice-President, the President-elect, and the Vice-President-elect. Others include former Presidents and their wives, widows of former Presidents, children under 16 of former Presidents, and major presidential and vice-presidential candidates.

The Secret Service guards visiting heads of foreign governments and, at the direction of the President, other distinguished foreign visitors. It also protects U.S. representatives performing special missions in other countries.

The Secret Service directs the Executive Protective Service and the Treasury Security Force. The Executive Protective Service, formerly called the White House Police, guards the White House, the Executive Office Building, and certain foreign diplomatic missions. The Treasury Security Force guards the Treasury Building, its annex, and the billions of dollars in currency and other securities that are stored in the Treasury vaults.

Applicants for positions as Secret Service agents must be college graduates in good health and must pass a civil service examination. Those who are accepted receive training in the protective and investigative functions of the agency.

Congress created the Secret Service in 1865 to fight the counterfeiting of U.S. currency. The service began protecting the President in 1901, after the assassination of President William McKinley.

A director heads the Secret Service. He is appointed by the secretary of the treasury. Secret Service headquarters are in Washington, D.C. The agency has district offices in major U.S. cities and in San Juan, Puerto Rico; and in Paris.

Secret Service publications include a pamphlet, *Know Your Money.* It tells how to detect counterfeit currency and how to guard against losses from forgery.

Critically reviewed by the UNITED STATES SECRET SERVICE

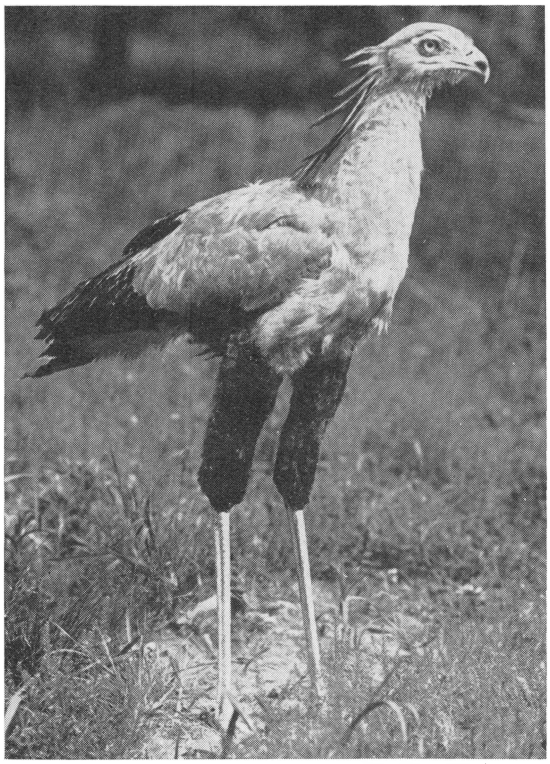
See also PRESIDENT OF THE UNITED STATES (Guarding the President).

SECRETARIAL WORK. See OFFICE WORK.

SECRETARIAT. See UNITED NATIONS; RUSSIA (The Communist Party); LEAGUE OF NATIONS (The Secretariat).

SECRETARY BIRD is a large African bird that looks like a hawk. Its name comes from the tufts of narrow feathers standing out from the sides and back of its head. The tufts resemble the quill pens that busy secretaries and clerks once carried behind their ears.

The secretary bird makes its home from Ethiopia and the Sudan to the Cape of Good Hope Province. It stands about 4 feet (1.2 meters) high and has long legs and a long tail. It usually prefers to run instead of fly. It builds a bulky nest in a tree or bush and lays 2 or 3 eggs at a time. They are dull white, spotted with rust.



New York Zoological Park

The Secretary Bird has long narrow feathers extending from the back of its head, resembling the old quill pens.

The bird eats frogs, insects, lizards, small tortoises, and snakes. Sometimes it flies with its prey and kills it by dropping it. Then it lands and eats it.

In the Cape of Good Hope Province, secretary birds destroy many snakes, and there is a fine for killing the birds. South African farmers sometimes tame secretary birds and keep them to kill rats.

Scientific Classification. The secretary bird belongs to the secretary bird family, *Sagittariidae*. It is genus *Sagittarius*, species *S. serpentarius*. OLIN SEWALL PETTINGILL, JR.

SECRETARY OF ————. For the secretaries of the executive departments of the U.S. government, see the articles on the departments. For example, see STATE, DEPARTMENT OF; DEFENSE, DEPARTMENT OF.

SECRETIN. See GLAND (Hormones of the Stomach and Intestines).

SECRETION, *see KREE shun*, is a substance that body cells form from blood. Cells that form a secretion are often grouped into a gland. A duct from the gland may then pour the product into another body part. Secretions from such glands include saliva, tears, mucus, sweat, bile, and digestive juices. The endocrine glands have no ducts. They return their secretions, called *hormones*, to the blood. Important hormones include *insulin*, *thyroxine*, and *epinephrine* (adrenalin). These hormones help to regulate *metabolism* (body processes). Working with other hormones, they regulate growth and health. EWALD E. SELKURT

Related Articles in WORLD BOOK include:

Gland	Insulin	Perspiration	Tears
Hormone	Mucus	Saliva	

SECTION, land. See PUBLIC LANDS (Management).

SECULARISM. See POLITICAL SCIENCE (Secularism).

SECURITIES. See INVESTMENT; BOND; STOCK, CAPITAL; MUTUAL FUND.

SECURITIES ACT OF 1933 was passed by Congress to protect the public from buying unsafe securities. It requires a detailed statement from each corporation planning to issue securities and offer them for sale in interstate commerce. These statements must be filed with the Securities and Exchange Commission before the securities are offered for sale. They must give complete details about the purpose and the financial backing of all new security issues. ROBERT D. PATTON

See also SECURITIES AND EXCHANGE COMMISSION.

SECURITIES AND EXCHANGE COMMISSION (SEC), an independent federal agency, administers federal laws governing the purchase and sale of *securities* (stocks and bonds). These laws were passed to protect people who invest money in securities. Companies offering stock for public sale must disclose information on company finances and other matters as long as their securities are offered to the public.

The SEC investigates complaints and possible violations of federal securities laws. It regulates national stock exchanges. It also licenses brokerage firms and investment advisers, and establishes codes of conduct for them. The SEC consists of five commissioners and has a staff of about 1,400. It was established in 1934.

Critically reviewed by the SECURITIES AND EXCHANGE COMMISSION

See also INVESTMENT BANKING; SECURITIES ACT OF 1933; STOCK EXCHANGE.

SECURITY COUNCIL. See UNITED NATIONS (The Security Council; picture).

SEDALIA, *see DAYL yuh*, Mo. (pop. 22,847), is the trading center of a large farming region. Every year, farmers bring their products to the state fair in Sedalia. The city lies in west-central Missouri, about 180 miles (290 kilometers) west of St. Louis and about 80 miles (130 kilometers) southeast of Kansas City (see MISSOURI [political map]). Whiteman Air Force Base is 18 miles (29 kilometers) west of Sedalia.

Sedalia is an important railway center. It ships corn, oats, wheat, and soybeans to all parts of the Middle West. Its products include shoes, work clothing, beverages, dairy and poultry products, and feed. Sedalia has a mayor-council government. The city is the seat of Pettis County. NOEL P. GIST

SEDAN, BATTLE OF. See FRANCO-PRUSSIAN WAR.

SEDATIVE, *SED uh tiv*, is a drug that acts on the nervous system to produce a state of calmness. Most sedatives produce sleep when taken in large doses. *Barbiturates* and *bromides* are commonly used sedatives.

Many drugs used to treat other conditions have a sedative side effect. Psychiatrists and other physicians sometimes prescribe *tranquilizers* for their patients. Tranquilizers produce calmness but do not decrease mental and physical activity. Some tranquilizers also have a sedative effect. Sedative side effects, however, may be undesirable. For example, some *antihistamine* drugs taken to control hay fever may cause drowsiness, making it dangerous for users to drive or work.

Some sedatives are habit-forming and others are *addictive* (create a mental and physical need). When a

person stops taking an addictive drug, he may experience *withdrawal illness*. That is, he may suffer a fever, nausea, or more serious illness. Sedatives should never be used unless they have been prescribed by a doctor or dentist for the person taking them. SOLOMON GARB

See also ANALGESIC; ANODYNE; BARBITURATE; DRUG ABUSE; NARCOTIC; TRANQUILIZER.

SEDDON, JAMES ALEXANDER (1815-1880), served as Confederate secretary of war from 1862 to 1865. A close friend of Jefferson Davis, Seddon influenced him more than any of the six men who served successively as his secretary of war. Seddon urged an offensive military campaign in the West to save the Confederacy. He was criticized in the Confederate Congress because he enforced such unpopular measures as the conscription act. He was born in Stafford County, Virginia, and was graduated in law from the University of Virginia. Before the Civil War, he was a member of the United States House of Representatives. RICHARD N. CURRENT

SEDGE, *sej*, is one of a large family of grasslike plants that grow in wet places throughout the world. Sedges thrive in marshes, swamps, and shallow water. Like grasses, they have long, narrow leaves. But sedges usually have triangular, solid stems. Grasses have round, hollow stems. Sedges have three rows of leaves, but grasses have only two.

The *sheath* (covering) at the base of each sedge leaf is closed around the stem. In grasses, the side of the sheath opposite the leaf blade is split and overlaps.

Sedges have tiny green flowers on small spikes called *spikelets*. These flowers have no petals, but they have small bristles. Farmers sometimes cut sedge for hay.

Scientific Classification. Sedges make up the sedge family, *Cyperaceae*. Common genera include *Carex*, *Cyperus*, and *Scirpus*. RICHARD W. POHL

See also GRASS; BULRUSH.

SEDGES, JOHN. See BUCK, PEARL S.

SEDGMAN, FRANK. See TENNIS (tables).

SEDIMENTARY ROCK, *sed uh MEN tar ee*, is rock formed when mineral matter settles out of water, or, less commonly, out of air or ice. Sedimentary rock covers about three-fourths of the earth's land area. In some places, such as at the mouth of the Mississippi River, sedimentary rocks are over 40,000 feet (12,000 meters) thick. Geologists estimate that sedimentary rock has been forming for at least $3\frac{1}{2}$ billion years. It is one of three major kinds of rock. The others are igneous rock and metamorphic rock.

The most common sedimentary rock is *shale* or *mudstone*. It is made of compressed mud or *silt* (fine particles of mineral matter). Other common sedimentary rocks include *limestone*, made of the mineral calcite, and *sandstone*, made of sand. *Conglomerate* is a sedimentary rock made of gravel cemented together. One kind of conglomerate, called *breccia* (pronounced *BRECH ee uh*) contains sharp, rather than smooth, pebbles.

Most sedimentary rock starts forming when silt and grains of sand settle along river beds or on the bottoms of lakes and oceans. Year after year, these minerals collect and form broad, flat layers called *beds* or *strata*. The layers, which differ in color and texture, distinguish sedimentary from most igneous and metamorphic rock. After thousands of years, layers of fine silt and clays are squeezed into compact layers by the weight of other layers above them. Water slowly oozing through coarse, sandy layers deposits mineral matter around the grains, cementing them together to form rock. When the earth's crust changes shape, large areas of sedimentary rock may be exposed.

Some sedimentary rock forms during the evaporation of water. For example, beds of rock salt were formed after ocean inlets were cut off by changes in the earth's surface. As the trapped water evaporated, layers of salt crystals were left behind.

Most fossils are found in sedimentary rock. The fossils formed when sediments covered dead plants and animals. As the sediments changed to rock, either the remains or the outlines of the plants and animals were preserved in the rock. See FOSSIL. SHELDON JUDSON

Related Articles in WORLD BOOK include:

Chalk	Flint	Rock (pictures; map)
Clay	Limestone	Sandstone
Concretion	Marl	Shale
Coral	Oil Shale	Travertine

SEDITION is an act which stirs up discontent against established government authority. Many countries, including the United States, have tried at times to prevent sedition by law. Americans, however, value the right to criticize government officials and their actions. Therefore, sedition laws are not popular in peacetime.

In time of war, statements which are likely to hinder the successful progress of the war are dealt with as sedition. Sedition is regarded as a step toward treason. But it does not aim at direct, open violence. The Espionage Act of 1917, enforced during World Wars I and II, provided punishment for seditious statements. It was used against enemy agents or other persons who tried to undermine the war effort. FRED E. INBAU

See also ALIEN AND SEDITION ACTS.

SEDNA. See ESKIMO (Religion).

SEDUM, *SEE dum*, is a *genus* (group) of plants that are decorative and hardy. Most sedums are native to the North Temperate Zone. They are *succulent* plants, or plants that store water in their thick, fleshy leaves (see SUCCULENT). Some sedums have low, creeping stems. Their leaves often grow in clusters near the ground. They are often used to cover rocks and bare ground. Others have tall stems and are used as border plants. Many persons call sedums *live-forevers* because they do not wither easily. They are also called *stonecrops*.

Sedum Plants usually do well in rock gardens. One kind of sedum, *below*, has wavy-edged leaves and flat clusters of starlike, yellow flowers.

J. Horace McFarland

Scientific Classification. Sedums belong to the orpine family, *Crassulaceae*. They are classified in the genus *Sedum*. H. D. HARRINGTON

SEE, ELLIOT McKAY, JR. See ASTRONAUT (table).

SEE, HOLY. See POPE (The Papacy).

SEEBECK, THOMAS JOHANN. See THERMOCOUPLE.

SEED. Seeds are the most important part of a plant. The roots, the leaves, the flowers, all exist so there can be seeds. And because each seed has been given the form that is best suited to produce its own kind of plant, there is great variety in their shapes, sizes, and colors.

Some seeds are round. Others are egg-shaped, triangular, circular, long and slender, curved, or coiled like a snail. Some seeds have horns, others have tails, and many have wings. Some are smooth, others are ridged. The color of the skin of the seeds varies also. It may be red, purple, orange, or any gay or dull color, striped or spotted, black or white. Many seeds look like beetles or pebbles in shape and color. In this way they escape seed-eating birds. The carrot seed is shaped like a hairy bug, the chickweed seed looks a little like a caterpillar, and the castor-oil seed resembles a shiny beetle.

The sizes of seeds vary almost as much as the different kinds of seeds. Tobacco seeds are so tiny that one seed pod may contain as many as 40,000 seeds. Poppy seeds are only slightly larger. From those tiny particles they range up through almost every size to the large Brazil nut and white walnut. The seed of one kind of coconut tree is so large that it weighs about 22 pounds (10 kilograms).

The size of the seed has no bearing on the size of the plant that will grow from it. The tallest tree in the world, the California redwood, grows from a very small seed. The large seed of a watermelon will produce only a low vine.

Some plants, such as ferns and mosses, do not have seeds. They reproduce their kind by means of spores (see SPORE). Many plants which bear seeds also have another method of reproduction. Onions, daffodils, and lilies develop bulbs from which new plants sprout. Strawberries have stems that creep along the ground. A new plant grows from each joint of the creeping stem. Lawn grass is thick because it has stems that creep underground, and new shoots sprout from the many joints. Potatoes have "eyes," and each eye is a plant bud.

Most plants, however, depend upon seeds alone to continue their kind.

How Seeds Develop

The part of a flower which contains the tiny seed-eggs is the ovary. To develop into healthy seeds the eggs must receive pollen from the same flower or the same kind of flower. Many changes then take place, and continue while the seed is developing.

Kinds of Seeds. All seeds are either *gymnosperms*, which are naked seeds (not enclosed in an ovary), or *angiosperms*, enveloped seeds (enclosed in an ovary which ripens as a pod or fleshy fruit). Naked seeds are like those of the pine and all other cone-bearing trees, and of certain fernlike plants of the tropics. The seeds of all plants—trees, shrubs, and herbs—that bear flowers are angiosperms.

Angiosperms that ripen in a dry seed pod are called *dry fruits*. When the seeds are surrounded by pulp, as in apples, peaches, and grapes, they are fleshy fruits.

When a plant has seeds with only *one* cotyledon, or seed leaf, it is called a *monocotyledon*. Iris, tulips, lilies, and corn are monocotyledons. Most plants have seeds with *two* cotyledons, or seed leaves. They are called *dicotyledons*. Beans and peas, and oaks, elms, and willows are dicotyledons. Nearly all cone-bearing trees, such as pine, spruce, and hemlock, are *polycotyledons*, because their seeds have *many* seed leaves.

Parts. The seed has three important parts—a protective outer skin, or *seed coat;* an *embryo*, which will become the new plant; and a food supply, or *endosperm*, usually in the form of one, two, or many *cotyledons*, or seed leaves. The cotyledons are stored with plant food—chiefly albumen and starch or oily matter. These nourish the embryo as it develops.

The seed coats of some seeds, such as the bean, have two structures, the *hilum* and the *micropyle*. The hilum is a small scar where the seed was attached to the seed stalk. The micropyle is a tiny hole where the pollen tube that fertilized the seed entered. The *epicotyl* and the *hypocotyl* are tiny parts of the cotyledon. The epicotyl becomes the stem of the young plant. The hypocotyl develops into the plant's first root.

Germination. It is interesting to study a Lima bean that has been soaked in water. The two cotyledons, or the two halves of the bean, are attached to one end of the embryo stem, which holds the plant bud, or the growing point. At the other end is the tip that will become the root.

When a bean is planted it swells with moisture so that it bursts its seed coat. Then the embryo begins to grow. The root tip pushes through the eye of the bean. The embryo stem does not lengthen until it has rootlets to anchor it firmly in the earth. It then arches up through the earth crust, and brings up the delicate plant bud protected by the tough cotyledons. As the stem straightens, the cotyledons open wide, and the bud is exposed to the light and air it needs for growth.

In some seeds, as most beans, the cotyledons are raised well above the earth. In others they remain at the earth's surface. When the small plant no longer needs their protection and food, they wither away.

In order to germinate, or sprout, a seed must have air, moisture, and the right temperature. Some seeds need a great deal of moisture, others only a little. Some will sprout in the cold ground of early spring. Others must have the sun-warmed ground of late spring or early summer.

Nearly all seeds thrive best if they are planted less than a year after they have ripened. But most of them will keep for some time. Two-year-old corn germinates readily, but if corn is kept for three or four years its chances of sprouting are slight. A bean may sprout if it is eight years old, but usually a bean embryo dies after the third year. Cucumber seeds may be kept for as long as ten years. And wheat has germinated after thirty years.

Each state in the United States has its testing station to determine the vitality of seeds, their germinating possibilities, and their purity from weed seeds and other undesirable seeds. Gardeners and farmers have learned that if they plant only the very best seeds their crops will be larger, healthier, and of better quality.

How Seeds Travel

Nature's work is not finished when seeds are ripened. They must have a chance to sprout and grow. If they fell straight to the ground, beneath the plant that bore them, they would be too crowded to thrive. A plant's

A WORLD BOOK SCIENCE PROJECT

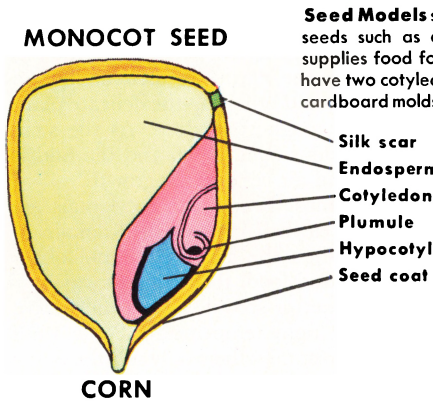
HOW SEEDS GROW

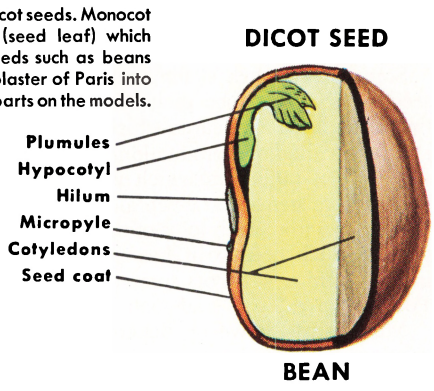
The purpose of this project is to learn how monocotyledon seeds differ from dicotyledon seeds at various stages of growth.

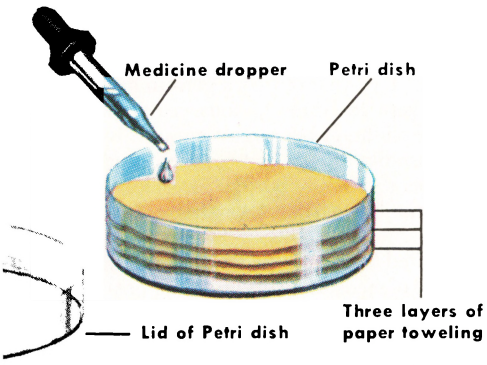
To Study Seed Growth for this project, the development of monocot and dicot seeds is compared at various stages of growth, *left*. Models of corn and bean seeds are made to show the important parts of each seed. To study plant development, seeds are allowed to sprout and the seedlings are preserved at various stages of growth.

PROCEDURE

Seed Models show the parts of monocot and dicot seeds. Monocot seeds such as corn have only one *cotyledon* (seed leaf) which supplies food for the growing seedling. Dicot seeds such as beans have two cotyledons. To make the models, pour plaster of Paris into cardboard molds shaped like the seeds. Paint the parts on the models.



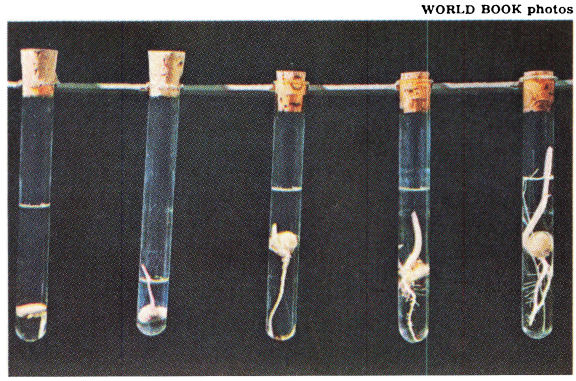




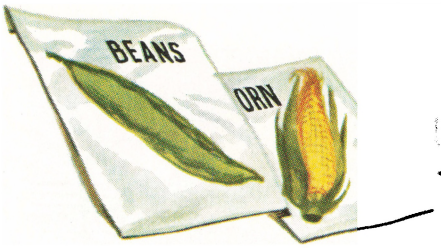
You can buy all the materials you need for this project from local stores. Get four Petri dishes. Cut three layers of paper toweling to fit the bottom of each dish. Dampen the paper toweling with a few drops of water. Place four bean seeds in each of the two Petri dishes, and four corn seeds in each of the remaining dishes. Cover the dishes and put them in a sunny place. The seeds will begin to sprout in about a day.

WORLD BOOK photos

Preserving the Seed Sprouts. Make a formalin-acetic-alcohol (FAA) solution by mixing 5 milliliters (ml) of glacial acetic acid, 10 ml of full strength formalin, 50 ml of isopropyl alcohol, and 50 ml of distilled water. Fill 10 test tubes three-quarters full of the solution. When the seeds begin to sprout, remove a corn seed and a bean seed from the Petri dishes. Place each seed in a test tube and put a cork in the tube. Repeat this procedure at intervals until you have samples of sprouts for each kind of seed at different stages of growth.

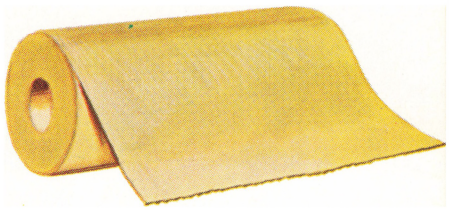


MATERIALS

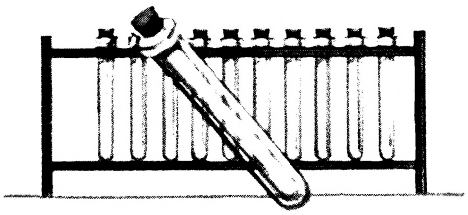


Bean Seeds and Corn Seeds

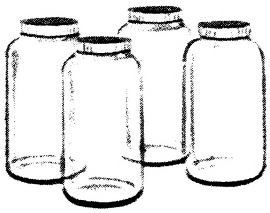
Petri Dishes with Lids



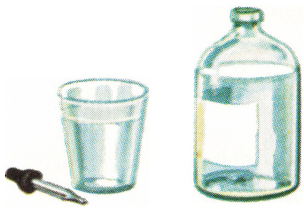
Paper Toweling



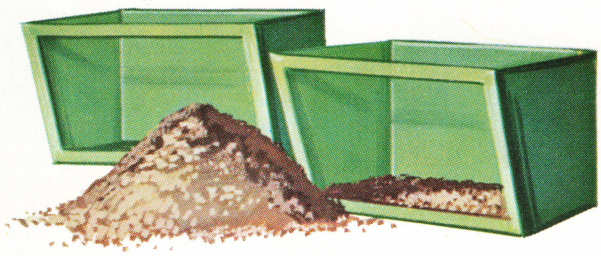
Test Tubes with Corks



Glass Jars with Lids



Formalin-Acetic-Alcohol Solution

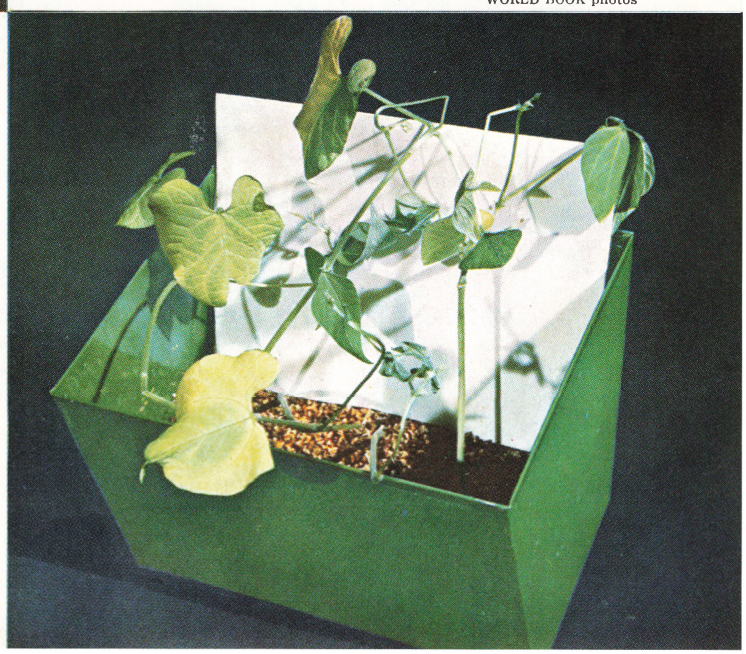


To Grow and Preserve the Seedlings, plant some of the beans and corn in germinating pans that have about 2 inches (5 centimeters) of Vermiculite (a growing medium) in the bottom. Dampen the Vermiculite and cover the pans. Remove the seedlings at different stages of growth and preserve them in small jars of FAA solution as shown, *left*.

WORLD BOOK photos

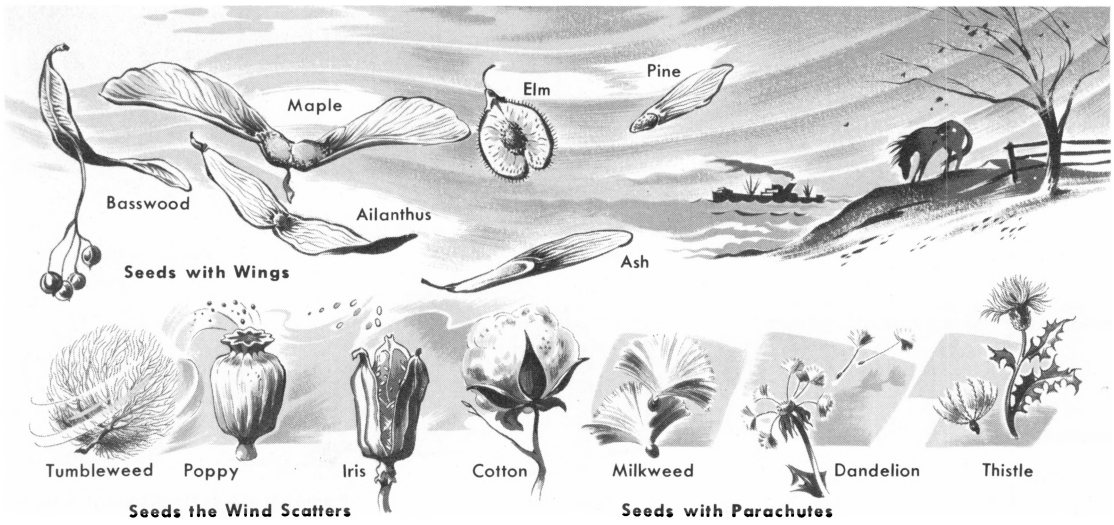
To Grow the Plants, plant the bean and corn seeds in germinating pans containing dampened Vermiculite. Cover the pans until seedlings appear. Then place the pans in a sunny place and after the first true leaves develop, add some fertilizer. Water the plants as necessary until they mature as shown, *right*.

Illustrated by Bill Fleming for WORLD BOOK



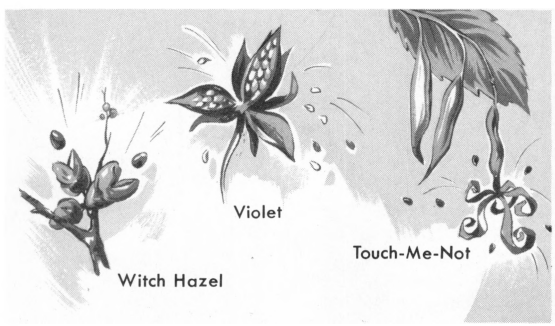
SEED TRAVELERS

Wind-Borne Seeds

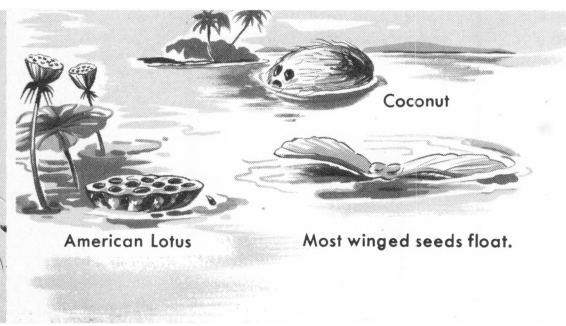


Seeds That Hitchhike

Seeds That Pop from Plants



Seeds That Travel by Water



seeds must be scattered, or dispersed. There are many ways in which this is done.

When the seeds of fleshy fruits are ripe, ready for planting, the skin of the fruit turns to a bright color, or even to black or white, to make it easy to see against the green leaves. Birds and other creatures are quickly attracted and eat the fruit. The seeds are not digested. They pass through the animal's body and are scattered in this way. Man helps by shipping fruits to distant points, or by eating them and throwing the seeds away. Most dry-fruit seeds are scattered by the wind.

When a dandelion's blowball head is ripe, each seed has a long tail tipped with a parachute of fluffy hairs. The wind snatches the seeds off and carries them, held up by their parachutes, far away. When they spin to the earth, the seed, which is the heavier end, sinks a little if the ground is soft. The first rain may beat it in, or an animal may tramp it into the earth—and so it is planted.

Milkweed, cotton, kapok, and other seeds are covered with fluffy down to enable them to sail on the wind. The clematis seed trails a long feathery plume.

A great many seeds have downy hairs that help them travel a long distance on the wind.

Other wind-borne seeds have delicate wings instead of down. The most familiar wings are probably those of maple seeds which grow in pairs. The pine seed's long wing is curved like a propeller blade. The wing helps the seed spin in the air, catch currents from all directions, and so travel farther. Ash, elm, and other trees have seeds with similar wings.

Many seeds that depend on the wind to scatter them have neither wings nor down. They ripen in dry pods or capsules. A pod such as a bean or milkweed pod has only one cavity. A capsule is divided into two or more compartments, or carpels.

In a great many cases, the pod or capsule splits open when it is dry. The seeds do not fall out and down. They wait for the wind. In an iris capsule they are packed so firmly they can not dislodge themselves, but when the wind shakes the stalk they are thrown out in every direction.

There are other ways in which the wind is useful in scattering seeds. The tumbleweed of the Western plains rolls itself into a ball when the seeds are ripe, and its roots dry and shrink. The first wind uproots the entire plant and sends it rolling over the prairies, scattering seeds as it goes.

Dry fruits with seeds too heavy for the wind to scatter have other methods. Some "shoot" their seeds out, forcing them to hop far away by an elastic contraction of the inner wall of the pod. When a bean pod dries and splits into two halves, it whirls the beans out in many directions by twisting or curling.

A familiar way for seeds to travel far from the parent plant is by means of hooks and barbs. These grasp and cling to the fur of passing animals. Burs, sticktights, and Spanish needles are very well known for they cling to the clothes of people who brush against them.

A great many of the seeds that are produced each year and are so well scattered never become plants. Many fall where conditions are not suitable for germination and growth. Many are eaten by birds and rodents. In many the embryo is not alive. Because of this tremendous loss of seeds, the plant produces a great number of them so that some will surely survive. One tobacco plant may ripen a million seeds. But when there is so enormous a quantity, the number of them that will sprout is very small. A coconut palm rarely produces more than a hundred seeds, often no more than twenty. Whenever there is a smaller number of seeds, very few can afford to be wasted.

Uses of Seeds

Seeds are of great importance to man. Their widest use is for food. Among all seed foods, cereals rank first. Rice is the most important. It is the chief food of millions of people in Asia and many in the Pacific Islands. Enormous quantities of wheat are consumed throughout the world. Other important cereals are corn, oats, barley, millet, buckwheat, and rye.

Edible fruits and nuts are seeds and seed coverings. Seed foods in the vegetable garden include beans, peas, tomatoes, eggplants, peppers, okra, cucumbers, squashes, pumpkins, and melons. Coffee, chocolate, and cocoa are beverages made from seeds. Vanilla flavoring comes from seeds. Mustard, black pepper, caraway, and nutmegs are other flavoring substances made from seeds.

Cotton is the fluffy down of seeds. Kapok is the down of similar seeds from a kapok tree.

Even more important in industry are the oils extracted from seeds. Cottonseed oil, linseed oil, castor oil, sunflower oil, soybean oil, coconut oil and palm oil are only a few. Seed oils have a multitude of uses. They are used for food as salad oils and cooking fats, and in making soaps and perfumery, linoleum, printer's ink, artists' colors, paints and varnishes, insecticides, and many other things. When the oil has been extracted from cotton seeds, sunflower seeds, and soybeans, the remaining pulp is used for cattle and poultry feed.

Seeds are used in making industrial alcohol, plastics, synthetic rubber, and medicine. Valuable seed medicines are strychnine and belladonna. VERNON QUINN

Related Articles in WORLD BOOK include:

Angiosperm
Cotyledon
Cross-Pollination
Dicotyledon
Flower (How Flowers Reproduce)
Fruit
Gardening (Starting the Garden)
Germination
Grain
Gymnosperm
Hilum
Nut
Plant (Seeds; How Plants Reproduce)
Pollen and Pollination
Spore
Tree (picture: Seeds of Trees)

Outline

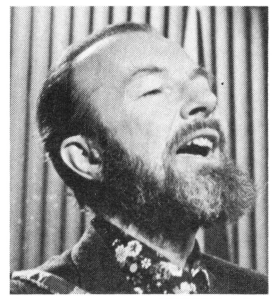
I. How Seeds Develop
A. Kinds of Seeds B. Parts C. Germination
II. How Seeds Travel
III. Uses of Seeds

Questions

Why are seeds the most important part of the plant?
Why do seeds have so many shapes and colors?
What are the two kinds of seeds? How do they differ?
What jobs do the different seed parts perform?
How do seeds get from place to place? How does the rest of the plant help them? How does nature help them?
Why is it necessary for so many seeds to be produced?
How are seeds valuable to man? What are some of their uses?

SEEGER, ALAN (1888-1916), an American poet, wrote one of the most memorable poems of World War I, "I Have a Rendezvous with Death." A feeling that he was going to die inspired him to write the poem. Later, he was wounded and died on the battlefield. His *Collected Poems* was published in 1916. Seeger was born in New York City. He joined the French Foreign Legion at the start of World War I. WILLIAM VAN O'CONNOR

SEEGER, PETE (1919-), is an American folk singer, musician, and composer. He first gained fame during the 1940's, singing about ordinary working people, war, and social problems. Seeger's musical style and concern with social issues influenced Joan Baez and many other folk singers. His best-known compositions include "Where Have All the Flowers Gone?" (1961).



NBC Television

Pete Seeger

Peter Seeger was born in New York City. He became interested in folk music at a folk music festival in 1935. He entered Harvard University the next year but left in 1938 to travel around the United States, singing and painting. In 1940, he helped found a folk group called the Almanac Singers. Seeger and Woody Guthrie, another noted folk singer and composer, both sang with this group. In 1948, Seeger helped organize the Weavers, a folk quartet. He sang with them until the late 1950's, when he became a solo performer. LEONARD FEATHER

SEEING EYE. See GUIDE DOG.

SEERSUCKER is a cotton or rayon material with crinkled stripes. It is used to make dresses and men's summer suits.

SEFERIS, GEORGE (1900-1971), a Greek poet and diplomat, won the 1963 Nobel prize in literature. He became the first Greek ever to win a Nobel prize. His symbolic, lyric verse shows his strong interest in Greece, its history, and its mythology. Seferis' books of poetry include *The Turning Point* (1931), *Mythistorima* (1935), *The Thrush* (1947), and *Log Book III* (1955). He also wrote essays, and translated into Greek works by T. S. Eliot and other poets.

Seferis was born George Stiliano Seferiadhis in Smyrna (now Izmir, Turkey). He moved to Athens in 1914 and to Paris in 1918. He returned to Greece in 1925, and served in the Greek Foreign Service from 1926 to 1962. Seferis was the Greek Ambassador to Great Britain from 1957 to 1962. He retired from diplomatic work in 1962.

SEGAL, GEORGE (1924-), is an American sculptor noted for his realistic, life-size plaster figures. Segal uses actual objects of everyday life with these figures. His figures, casts of actual bodies, sit on real chairs, look out of real doorways or windows, and sit behind actual automobile steering wheels.

Segal works in a kind of realism characteristic of many young artists of his day. His work lacks symbolism or obvious emotion. He seems to present the figures as objects, rather than personalities. But they take on a fresh intensity because of their isolation and lack of normal human associations. Segal was born in New York City. ALLEN S. WELLER

See also UNITED STATES (The Arts [picture]).

SEGO LILY, *SEE goh*, is one of the mariposa lilies, a group of over 40 bright flowering herbs native to western North America. It is the state flower of Utah (see UTAH [color picture]). *Mariposa* is a Spanish word for butterfly, and the petals of the sego lily look like a butterfly's wings. They are white, tinted with yellowish-green or lilac, and have a spot of purple at the base. The sego lily is native from Washington to New Mexico, but can be grown in the Northeastern states if it is protected from frost. The flower grows on a stem about $1\frac{1}{2}$ feet (46 centimeters) tall, and the leaves are long and thin. The plant has a thick underground stem that looks like a bulb. The early Mormons in Utah cooked and ate these stems.

Scientific Classification. The sego lily belongs to the lily family, *Liliaceae*. It is classified as genus *Calochortus*, species *C. nuttallii*. DONALD WYMAN

SEGOVIA, *say GOH vyah*, **ANDRÉS** (1893-), is one of the world's foremost guitarists. His remarkable virtuosity and musicianship helped elevate the guitar to importance as a solo instrument. His programs contain transcriptions of classic and romantic music and works written for him. Segovia was born in Linares, Spain. DAVID EWEN

SEGRÈ, EMILIO. See NOBEL PRIZES (table: Nobel Prizes for Physics—1959).

Girl Holding a Cat (1968); Mrs. Helen Segal Collection (Hans Namuth)

A Typical George Segal Sculpture is a realistic life-size plaster cast of a human figure in everyday surroundings.

SEGREGATION is the separation of groups of people by custom or by law. It is often based on differences of race, religion, wealth, or culture. Whatever the differences may be, many persons consider them highly important.

Segregation can occur in almost any area of life. It is particularly evident in housing, education, and employment, and in the use of eating, sleeping, transportation, and other public facilities. Almost all systems of segregation discourage marriage between persons of different racial, religious, or social groups. In the United States, for example, many states outlawed marriage between Negroes and whites. But in 1967, the Supreme Court of the United States ruled such laws unconstitutional. Segregation almost always involves some kind of discrimination by one group against another.

The term *desegregation* refers to the process of ending group separation. It generally is used to describe efforts to abolish racial segregation in the United States. The people most affected by racial segregation—in the United States and elsewhere—have been Negroes.

During the course of desegregation, two or more separated groups may begin to act toward each other in new, friendlier ways. The process of *integration* goes further, and refers also to the quality of the new relationship. A desegregated situation becomes integrated when it involves acceptance and friendship between persons in different groups. For example, a desegregated school is no longer all-Negro nor all-white—but there may be little friendship between the Negro and white students. After student friendships form across racial lines, the school is truly integrated.

Segregation is not limited to the United States nor to discrimination against racial minorities. It has been practiced in various forms in many countries throughout history.

Causes and Effects of Segregation

Segregation is usually the result of a long period of group conflict, with one group having more power and influence than another. In time, both groups develop beliefs and attitudes that support the system of separation. Segregation comes to be seen as "right"—particularly by the dominant group—and as the only way society should be organized. When people violate the accepted code of group separation, their action is considered "wrong" and deserving of stern punishment.

Further support for segregation comes from hostile attitudes and feelings between groups. The dominant group typically believes its members are born with superior intelligence, talents, and moral standards. These attitudes help ease the dominant group's guilt for its mistreatment of the *subordinate* (less powerful) group. The subordinate group, in turn, develops fear and extreme dislike toward the dominant group. Such attitudes and actions tend to maintain segregation.

Segregation usually involves favored treatment for the dominant group. Members of this group are expected to have—and usually do have—the best education, homes, jobs, and public services. As a result, their beliefs of superiority are strengthened. They do not consider the system unfair, but regard it as the proper way for society to distribute its resources. Likewise, the subordinate group has a sense of inferiority that is reinforced by a system that denies it the social benefits enjoyed by others. Each group naturally views the other as fundamentally "different." Sometimes, subordinated groups try to make up for their low status. They develop intense group loyalty, and make special efforts to overcome the limitations of separation.

A segregated society runs the risk of its groups growing apart and developing highly different values and ways of life. Eventually, the differences may become so great that they cause serious conflicts between the groups. These differences reduce the chances for peaceful desegregation and integration in the future.

Thomas F. Pettigrew, the contributor of this article, is Professor of Social Psychology and Sociology at Harvard University and author of A Profile of the Negro American.

Racial Segregation in the United States

Racial segregation in its modern American form started in the late 1800's. But slavery existed in the United States for more than 200 years before the Civil War (1861-1865). After the war, the freed Negroes suffered widespread discrimination, especially in the South. See CIVIL WAR; RECONSTRUCTION.

Jim Crow Laws were adopted by many Southern states in the late 1800's. These segregation laws required that whites and Negroes use separate public facilities. No detail was too small. At one time, for example, Oklahoma required that whites and Negroes use separate telephone booths. Arkansas specified separate gambling tables, and many courts provided separate Bibles for swearing in witnesses. Several Southern states adopted "grandfather clauses" and other Jim Crow laws that deprived Negroes of their voting rights. See GRANDFATHER CLAUSE; JIM CROW.

The rapid spread of segregation laws through the South was supported by a series of decisions by the Supreme Court of the United States. The most influential case was *Plessy v. Ferguson* in 1896. In that case, the court supported the constitutionality of a Louisiana law requiring separate but equal facilities for whites and Negroes in railroad cars. The era of *de jure* (by law) racial segregation in America began with this decision. For over 50 years, many states used the "separate but equal" rule to segregate the races in public schools, and in the use of transportation, recreation, sleeping, and eating facilities.

The Beginning of Change. The system of de jure segregation gradually began to crumble in the 1900's. During World War I (1914-1918), orders for military equipment created a great demand for labor. The demand led to mass Negro migration from the South to the manufacturing centers of the North. This migration is still going on. In 1910, only about a tenth of all Negro Americans lived outside the South. Today, more than half live outside the South. The majority of Negroes live in the largest metropolitan areas. For example, New York City has more Negroes than any Southern state.

Starting in the 1930's, Negroes have gained increasing importance in national politics and a fairer hearing in federal courts. The high point was reached in the 1954 case of *Brown v. Board of Education of Topeka*, in which the Supreme Court ruled against de jure segrega-

tion in public schools. The court held that "in the field of public education the doctrine of 'separate but equal' has no place. Separate educational facilities are inherently unequal." In 1969, the court ordered public school districts to desegregate "at once."

De Facto Segregation. In the 1960's, national attention shifted to so-called *de facto* segregation. This type of separation has developed more by custom than by law.

Although many laws supporting de jure segregation have been declared unconstitutional, de facto racial separation has increased. In American cities, Negroes were more residentially segregated in the 1960's than in the 1930's. A larger percentage of Negro children attended predominantly Negro public schools in the late 1960's than at the time of the Supreme Court's desegregation ruling in 1954.

Efforts to eliminate segregation have benefited middle-class Negroes. This group, which accounts for about a fourth of all Negroes, has the education and the skills to take advantage of new opportunities. But the situation has not improved basically for millions of unskilled, low-income Negroes. In many ways, poor Negroes are relatively worse off than they were in the 1930's. Although their standard of living has improved, it has not risen so fast as that of whites and middle-class Negroes. In addition, the gap between their goals and the realization of those goals has widened.

De facto segregation was a basic cause of the race riots that swept American cities in the 1960's. The riots represented, among other things, a mixture of despair, desperation, and defiance. Many social scientists believe that racial unrest will continue until de facto segregation begins to decrease and the living conditions of poor Negroes improve significantly.

Antidiscrimination laws are a major tool for breaking down de facto segregation. For example, the Civil Rights Act of 1968 provides protection against discrimination in the sale or rental of housing (see OPEN HOUSING). Many sociologists predict that such laws, if enforced and respected, will bring about changes in racial attitudes and lead to improved race relations.

For more information on discrimination against Negroes, see the article on NEGRO.

Other Segregation in the United States

The United States has sometimes been described as a huge "melting pot" where races and cultures intermingle and live in peace. But the pot has not "boiled" evenly for all groups. Other minorities besides Negroes have been subjected to segregation and discrimination.

Immigrants and nonwhites have been frequent victims of discrimination. In the 1800's, for example, white settlers took vast areas of land from the American Indians and forced them to move onto reservations. Since then, most Indians have been treated as second-class citizens. Orientals also have suffered discrimination. In the late 1800's and early 1900's, Congress passed *exclusion acts* to stop immigration from China and Japan. During World War II, after Japan attacked Pearl Harbor in 1941, thousands of patriotic Japanese-Americans were suspected of being disloyal to the United States. They were placed in detention camps and lost many of their constitutional rights. Immigrants from Mexico, Puerto Rico, and southern and eastern Europe have also suffered discrimination. See also INDIAN, AMERICAN (Indians Today); ROOSEVELT, THEODORE (Friction with Japan); MEXICAN AMERICANS.

Segregation of other minorities has generally been less forceful and less obvious. Many Jewish Americans, for example, have been excluded from certain residential areas. Many have also been discriminated against in educational and job opportunities by "quotas" that limited Jewish participation. These practices have steadily declined since the 1940's.

Sometimes segregation is voluntary rather than forced. For this reason, sociologists distinguish between a *segregated ghetto* and an *ethnic area of choice*. A ghetto is, in effect, a prison, because forced segregation gives its people little choice of living elsewhere. An ethnic area of choice is a community where members of a group prefer to live, though they could live elsewhere. Ethnic areas of choice are particularly common among groups with a distinctive language and culture. For example, many U.S. cities have large communities of such groups as Germans, Italians, Jews, or Poles. See ETHNIC GROUP.

Segregation in Other Countries

Segregation has existed since history began. During the Middle Ages, from the 400's to the 1500's, segregation was especially directed against European Jews. In many countries, Jews had to live in city ghettos. Laws prohibited them from owning land, joining labor guilds, or entering medicine, law, or other professions. As a result, these Jews could earn a living only in occupations avoided by Christians, including money lending and tax collecting. In time, people came to think of Jews as a clannish group that dealt dishonestly in trade. Jews were blamed for all types of misfortunes, even the plagues which swept Europe during the Middle Ages. See JEWS (Persecutions of the Jews).

Segregation also can occur within a religion, with sacred approval. An example is the complex Hindu system of separation by *castes* (social classes) in India. For about 2,000 years, the many castes remained strictly separated in almost all areas of life. In 1948, the Indian government began a campaign against the caste system. Progress has been made, but segregation remains in many parts of India. See CASTE; INDIA (Hinduism).

In some countries, segregation and discrimination are based on national and racial differences. For example, Koreans living in Japan are typically segregated, discriminated against, and regarded as inferiors by the Japanese. South Africa has the world's most complete system of racial segregation. The South African government, which is controlled by whites, follows a racial policy called *apartheid* (pronounced *ah PAHRT hayt*). Apartheid aims to separate the races in every walk of life. See APARTHEID; SOUTH AFRICA.

Since the early 1940's, segregation has declined steadily throughout the world. Several forces have led to increased contact across class, cultural, racial, religious, and national lines. These forces include the global scale of World War II, the end of colonialism, the expansion of literacy, and the rapid growth of cities. Other forces have been mass migrations and the growth of rapid transportation systems and of mass communication.

THOMAS F. PETTIGREW

See also RACISM.

SEGREGATION, LAW OF. See HEREDITY (Gregor Mendel).

SEICHE, *saysh*, is a long wave in the relatively shallow water of a lake, bay, or harbor. The wave may be anywhere from 2 inches (5 centimeters) to 10 feet (3 meters) or more in height. High winds, a small earthquake, or atmospheric changes may cause a seiche. Minor seiches occur daily on Lake Geneva in Switzerland, and on Lake Superior.

Small seiches occurred at San Francisco in 1883, after the Krakatoa volcanic eruption (see KRAKATOA). A more recent seiche struck 25 miles (40 kilometers) of the Lake Michigan shoreline from Whiting, Ind., to Waukegan, Ill., on June 26, 1954. Eight persons were drowned by the wave, which was 10 feet (3 meters) high. High winds and a sudden rise in air pressure over the lake apparently formed the seiche.

SEIDL, *ZYE dl*, **ANTON** (1850-1898), an orchestra conductor, greatly influenced musical life in the United States with his interpretations of Richard Wagner's operas. He worked with Wagner in copying many of his scores, and helped with arrangements in 1876 for the first Bayreuth festival (see BAYREUTH).

Seidl came to the United States to conduct German opera at the Metropolitan Opera House in New York City in 1885. He conducted the orchestra of the New York Philharmonic Society from 1891 to 1898. He conducted the first performance of Antonín Dvořák's famous *Symphony in E minor: From the New World*, in 1893. Seidl was born in Budapest, Hungary. IRVING KOLODIN

SEIDLITZ POWDERS, *SED litz*, also called *Rochelle salt*, are used in a gentle laxative drink. They are named for a Bohemian spring of carbonated water. They are often put up in two packages, one blue and one white. The blue paper contains a sodium and potassium tartrate with sodium bicarbonate. The white contains an acid tartrate. The powders are first dissolved separately in two half-tumblers of water. One solution is then poured into the other. The mixture begins to fizz, and should be drunk at once. The powders give best results when taken on an empty stomach. AUSTIN SMITH

SEIGNEURIAL SYSTEM, *seen YOO ree uhl*, also spelled SEIGNIORIAL, was a method of landholding the French brought to eastern Canada (New France) in the 1600's. Seigneuries were tracts of land the king of France gave to noblemen or rich merchants called *seigneurs*. Most of the tracts covered from 12 to 100 square miles (31 to 260 square kilometers). The seigneurs rented sections of their land to *habitants*. The habitants were poor peasants who made their living farming the land. They paid a small rent, performed military service when needed, and worked three to six days a year without pay for the seigneur. About 300 seigneuries were granted between 1598 and 1788. Most were along the Saint Lawrence River. The Canadian legislature abolished the seigneurial system in 1854.

SEINE RIVER, *sayn*, and its branches form the chief commercial waterway of France. It rises 18 miles (29 kilometers) northwest of Dijon. From there, the Seine flows in a winding course about 475 miles (764 kilometers) northwest to its mouth in the English Channel near Le Havre. About 235 miles (378 kilometers) from its source, it becomes the broad river that flows through the heart of Paris. In Paris, its waters move under more than 30 bridges, some of which were built over 300 years ago. On the left bank of the Seine in Paris are the Latin Quarter, the Sorbonne, and the Luxembourg Gardens. On its right bank are the Louvre, the Champs Élysées, and the Trocadero. The Cathedral of Notre Dame stands on an island in the Seine.

French Embassy Press and Information Division

The Seine River flows through the heart of Paris. The new Grenelle Bridge, above, is one of many that cross it.

Small boats carry people and goods westward from Paris on the Seine past Saint Cloud, famous for its horse races, and past Saint Germain with its handsome palaces. The Seine then winds through the province of Normandy to Rouen, where seagoing ships dock. Southeast of Paris, the river flows through Fontainebleau, past wheat fields, orchards, and vineyards.

The Seine is important to commerce as well as being a beautiful, winding river. It is joined by the Aube, Marne, Yonne, and Oise rivers. Canals connect the Seine with the Loire, Rhône, Rhine, Meuse, and Schelde rivers. Boats can sail about 340 miles (547 kilometers) of its length. The Seine has flooded its banks seven times. It caused extensive damage to crops and property when it rose more than 24 feet (7 meters) during a flood in 1910. W. R. MCCONNELL

See also PARIS.

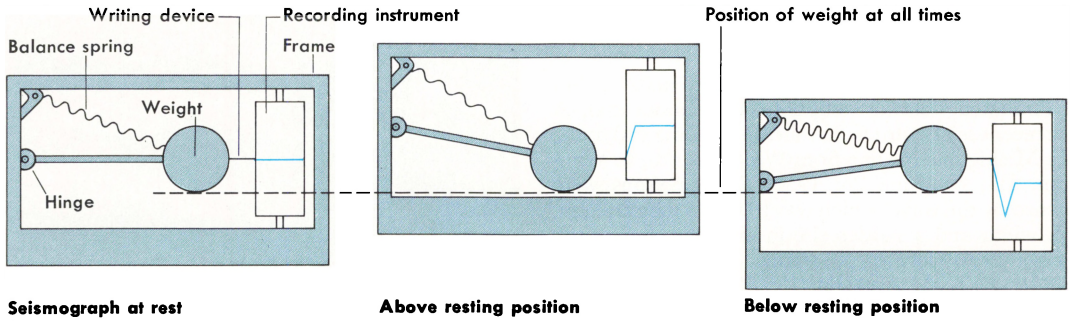
SEINING. See FISHING INDUSTRY (How Fish Are Caught).

SEISMOGRAPH, *SIZE moh graf*, is an instrument that amplifies and records small movements of the ground. From these records, scientists called *seismologists* can determine the location and size of earthquakes. Scientists also use seismographs to hunt for oil, to study the earth's interior, and to find the thickness of glaciers.

The most sensitive seismographs magnify ground motion by as much as ten million times. They consist of a weight suspended from a frame by a delicate spring. The frame moves with the ground. But the weight, due to its inertia, tends to remain stationary (see INERTIA). The relative motion between the weight and the frame is magnified by using an electromagnetic transducer and an electronic amplifier. The transducer, a coil attached to the weight, moves in the magnetic field created by a magnet attached to the frame. This movement induces an electric voltage in the coil which passes to the amplifier. The amplified voltage controls a recording device that marks the ground motion on a

HOW A SEISMOGRAPH WORKS

A seismograph draws a wavy line, *right*, to show the motion of the earth during an earthquake. The simplified diagrams below show how the instrument records this motion.



The main parts of a seismograph are a recording instrument and a weight. Any movement of the earth causes the seismograph frame to move up and down, but the weight does not move. A writing device attached to the weight marks a record of the earth's motion on the recording instrument. The diagrams show the seismograph at rest, and then above and below its resting position.

WORLD BOOK diagram

moving sheet of paper. The seismograph can detect ground motion as small as 39 ten-billionths of an inch (1 hundred-millionth of a centimeter).

Different types of seismographs are used to measure short and long seismic waves. The *Press-Ewing* seismograph records long waves at least 500 miles (800 kilometers) in length. The *Benioff linear strain* seismograph measures changes in distance between two piers attached to the ground.

Seismographs are used in groups of three to measure separately three types of ground motion: up-down, north-south, and east-west. There are more than 500 seismograph stations throughout the world.

The seismographs used for scientific studies and prospecting are tiny and rugged. Scientists place hundreds of these seismographs around the site being studied. Then, the scientists set off explosives to create seismic waves, which travel to underground rock layers and are reflected. The seismographs measure the reflected waves and indicate what lies beneath the surface.

The Apollo astronauts placed five special seismographs called *seismometers* on the moon. These instruments detected seismic waves caused by tiny moonquakes and sent information about the waves back to the earth by radio. The seismometers indicated that the moon has a thick, strong crust. FRANK PRESS

See also EARTHQUAKE; PETROLEUM (Analyzing Earth Conditions); RICHTER MAGNITUDE; SEISMOLOGY.

SEISMOLOGY, *size MAHL oh jee*, is the study of earthquakes. When an earthquake occurs, the sudden and violent movement beneath the surface causes shock waves, called *seismic waves*, to radiate through the earth. The waves nearest the center of the earthquake may shake the ground so severely that buildings crack and fall. But as the waves travel away from the center, they become weaker and less destructive. The strength and direction of these waves can be measured by a sensitive instrument called a *seismograph* (see SEISMOGRAPH).

Seismologists, scientists who study earthquakes, use the seismograph to determine the *epicenter* (site of the earthquake) and the *Richter magnitude* (strength). They may also determine the size of the earthquake by comparing the shock felt by people in the area and the amount of damage with the *Modified Mercalli Intensity Scale*.

Information gathered in seismology helps engineers construct buildings that can resist shock. Seismic waves from earthquakes and explosions are used to explore the earth's interior. For example, it is known that certain types of waves, called *shear waves*, do not travel through liquids. A seismograph, on the other side of the earth, opposite the epicenter, will not record shear waves. This indicates that the earth may have a liquid core because other waves from the same earthquake are recorded. Seismic waves are also used to measure the thickness of the earth's crust, to find underground oil and water reservoirs and to locate underground nuclear explosions. FRANK PRESS

See also EARTHQUAKE; SEISMOGRAPH.

SEJM. See POLAND (Government).

SEKONDI-TAKORADI, *sek un DEE tah kuh RAH dee* (pop. 91,874; met. area pop. 160,868), is the third largest city of Ghana. It lies on the Gulf of Guinea, about 110 miles (177 kilometers) west of Accra (see GHANA [map]). The city has a modern harbor and a railroad links it with other cities in Ghana. Industries include fishing, railroad repair shops, and sawmills. The Dutch founded the city in the 1600's. ALAN P. MERRIAM

SELASSIE, HAILE. See HAILE SELASSIE I.

SELDEN, GEORGE. See AUTOMOBILE (Selden Case).

SELECTION, NATURAL. See NATURAL SELECTION.

SELECTIVE SERVICE SYSTEM (SSS) is an independent agency of the United States federal government. Its job is to provide enough drafted men to maintain the authorized strength of the armed forces. The SSS consists of a national headquarters, state headquarters, local boards, state appeal boards, and the National Appeal Board. The President, with the Senate's approval, chooses the director of selective service. Young men

18 years of age and over must be registered with their local board. Each local board is made up of three or more members. The local board decides upon the classification of each registrant. Registrants may appeal these decisions. See also DRAFT, MILITARY (The Selective Service System). Critically reviewed by SELECTIVE SERVICE SYSTEM

SELENE, *sih LEE nee*, was the goddess of the moon in Greek mythology. The Roman goddess Luna resembled her closely. Helios, the sun, was Selene's brother. Every day, Helios drove his fiery chariot across the sky. At night, after his return, Selene drove her own chariot across the sky. The rays from her golden crown lit up the night.

Selene played an important part in ancient magic rituals, but she appears in few myths. The best-known story about Selene tells of her love for Endymion, a handsome mortal. Either Selene or Zeus, the king of the gods, caused Endymion to fall into an eternal sleep. Myths differ on why Endymion was put to sleep.

Some ancient sources say Selene was the daughter of Hyperion and Theia. Others say she was the child of Zeus and Leto. Many ancient Greek writers confused Selene with the goddess Artemis. As a result, some myths incorrectly identify Artemis, rather than Selene, as the moon goddess. C. SCOTT LITTLETON

See also ARTEMIS; ENDYMION; LUNA.

SELENITE. See GYPSUM.

SELENIUM, *seh LEE nee uhm*, is an element related to sulfur. The Swedish chemist Jöns J. Berzelius discovered it in 1817. Selenium is classed as a nonmetal. But it acts like a metal because it conducts electricity when light shines on it. This makes selenium useful in devices that depend on changes in electric current that are produced by changes in light. Such devices include *photoelectric cells* (electric eyes), television cameras, and certain copying equipment.

Industry uses selenium as a semiconductor in solar batteries and rectifiers. It is also used to color glass and ceramics red, and to harden rubber. Selenium is obtained from lead, copper, and nickel refining.

Selenium occurs either as dark-gray, lustrous rods, or as dark-red crystals or powder. It has the symbol Se. Its atomic number is 34, and its atomic weight is 78.96. It melts at 217° C (423° F.) and boils at 684.9° C ±1.0° C (1264.8° F. ±1.8° F.). J. GORDON PARR

SELEUCID DYNASTY, *see LOO sid*, lasted from 305 B.C. until 64 B.C. Seleucus I, a general under Alexander the Great, started the *dynasty* (series of rulers), which was centered in Syria and Mesopotamia. The Seleucids fought many wars with the Ptolemies, rulers of Egypt. Antiochus III, a Seleucid king, lost much land to the Romans about 190 B.C. Judas Maccabaeus led a Jewish revolt against Antiochus IV in the 160's B.C. By 129 B.C., the Seleucids had lost Mesopotamia, and their power had declined in Syria. Syria became a Roman province in 62 B.C. THOMAS W. AFRICA

See also JUDAS MACCABAEUS.

SELF-BINDER. See REAPING MACHINE.

SELF-DENYING ORDINANCE was an act passed during the Civil War between the English Parliament and Charles I. It required all members of Parliament to resign from civil or military office. Cromwell and the Independents carried this "self-denying ordinance" through Parliament. It was designed to get rid of inefficient commanders and to give control of the remodeled army to the Independents. See also CROMWELL, OLIVER; LONG PARLIAMENT. J. SALWYN SCHAPIRO

SELF-DETERMINATION. See WORLD WAR I (Results of the War).

SELF-GOVERNMENT. See GOVERNMENT; HOME RULE; STUDENT GOVERNMENT.

SELF-POLLINATION. See FLOWER (Pollination).

SELIGMAN, *SEL ig mun*, **EDWIN ROBERT ANDERSON** (1861-1939), was an American economist and pioneer in public finance. He vigorously opposed the single tax on land value advocated by the reformer Henry George (see GEORGE, HENRY). Instead, Seligman proposed a personal income tax. He justified progressive taxation based on ability to pay. His book *The Income Tax* (1911) discussed principles which Congress put into practice in the new income tax law of 1913. Seligman was born in New York City. DUDLEY DILLARD

SELJUK, *sell JOOK*, was the name given Turks who advanced from Turkestan in the middle 1000's and gained control of the Caliphate of Baghdad. They adopted Arabic culture and became the champions of Islam against the Christians in the age of the Crusades.

The unity of Seljuk rule lasted barely 50 years. During the 1100's several independent Seljuk sultans ruled realms in the Near East. Seljuk power was weakened by the Crusaders and by the Mongols under Genghis Khan. The rise of the Ottoman Turks at the end of the 1200's ended Seljuk power. WILLIAM F. MCDONALD

SELKIRK, ALEXANDER (1676-1721), was a Scotsman whose experiences as a castaway on a lonely island inspired the story of Robinson Crusoe (see ROBINSON CRUSOE). While sailing in the South Seas in 1704 on a pirate expedition, Selkirk quarreled with the ship's captain. At his own request, he was left on one of the Juan Fernández islands, about 400 miles (640 kilometers) west of Valparaíso, Chile. He lived alone for 52 months, until Captain Woodes Rogers rescued him.

The captain recorded Selkirk's experiences on the island in *A Cruising Voyage Around the World.* Captain Edward Cooke described them in *A Voyage to the South Seas* and *Round the World.* Selkirk was born at Largo, Fifeshire. See also JUAN FERNÁNDEZ. FRANK GOODWYN

SELKIRK, EARL OF (1771-1820), THOMAS DOUGLAS, was a British philanthropist and colonizer. A man of warm sympathies, he interested himself in the welfare of the Scottish tenant farmers who were being forced off estates in the Highlands area to make room for sheep runs. In 1803 he placed 800 of these people on Prince Edward Island in Canada. Later, he colonized the Red River Valley of Manitoba. He was born on St. Mary's Isle, Kirkcudbrightshire (now Dumfries and Galloway Region), Scotland. WILLIAM R. WILLOUGHBY

SELKIRK MOUNTAINS, a range in southeastern British Columbia, extends north from the United States boundary to the Columbia River. The Columbia River and its tributary, the Kootenay, run almost completely around this range. The Selkirks are not so high as the Rocky Mountains, which lie 70 miles (110 kilometers) to the east, but they are considered more beautiful. The largest of the many glaciers in the Selkirks is the Illecillewaet, near the Glacier House station of the Canadian Pacific Railway. Mount Sir Sanford (11,590 feet, or 3,533 meters) is the highest peak in the Selkirks.

The range is about 200 miles (320 kilometers) long, and about 80 miles (130 kilometers) wide. Gold was discovered there in 1857, and silver, copper, zinc, mercury, coal, and marble also have been found. The mountains were named for Thomas Douglas, Earl of Selkirk. RODERICK HAIG-BROWN

SELLING. See SALESMANSHIP.

SELLING SHORT. See BOARD OF TRADE.

SELVA is the thickly forested plain of the Amazon Valley in South America. It is often called the rain forest because the rainfall is so heavy in the region. The selva extends from northern Brazil to southern Venezuela. The plant life of the selva includes such trees as rubber, bamboo, rosewood, Brazil nut, cacao, and wax palm. Thick tangles of tropical plants grow among the trees in the selva. ERNEST L. THURSTON

SELYE, *SEH lyay*, **HANS** (1907-), a Canadian scientist, became known for his concept of *stress*. He helped show the nature and effects of disease and the reaction of our bodies to the wear and tear of living. His medical research showed what can be done to adjust ourselves to energy depletion. Selye became director of the Institute of Experimental Medicine and Surgery at the University of Montreal in 1945. He was born in Vienna. NOAH D. FABRICANT

SEMANTICS, *see MAN ticks*, in logic, is the study of the conditions under which signs and symbols, including words, may be said to be meaningful. It is also the study of how human behavior is affected by words, whether spoken by others or to oneself in thought. In philology, the scientific study of languages, semantics used to mean the historical study of changes in the meanings of words.

Semantics may be said to ask such basic questions as: "What are you talking about—if anything?" and "What are the relations between words and the things talked about?" Semantics deals with meaning as a factor in all human relations. Human beings are the only creatures who can talk themselves into trouble, and semantics is concerned with how to avoid doing so.

Modern semantics originated in the early 1900's in what an English philosopher, Lady Viola Welby, called *significs*. She described it as "the science of meaning or the study of significance, provided sufficient recognition is given to its practical aspect as a method of mind." Lady Welby felt that a proper study of meaning should begin with the study of what words are about, namely, experience.

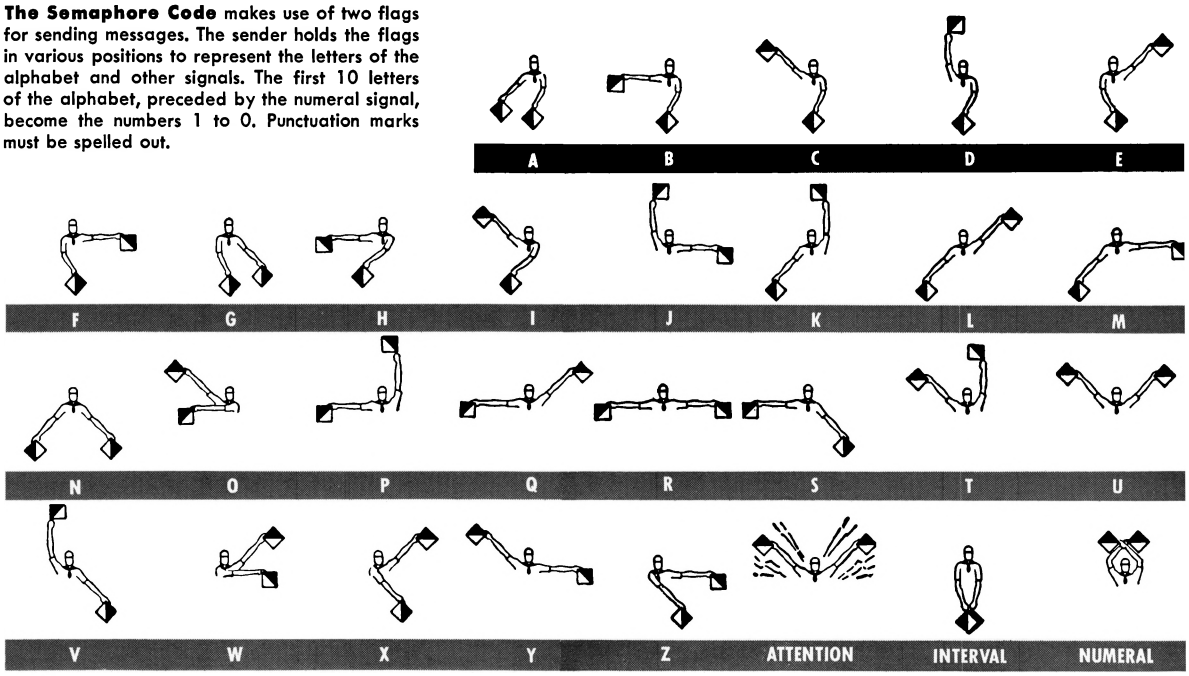
C. K. Ogden, a British psychologist, and I. A. Richards, an English literary critic, contributed insights from psychology, anthropology, and the physical sciences. They showed how emotive utterances are often mistaken for statements of fact; how meaning is determined by context; and how disputes are caused by lack of awareness of verbal traps. The *operationalism* of P. W. Bridgman, an American physicist, added much to semantics. According to this theory, a statement may be said to have meaning only if it can be translated into operations to test it. If a table is said to be 5 feet long, a person can measure it with a ruler. But if one says "Man is born free, but everywhere he is in chains!" what operations could verify this assertion?

Alfred Korzybski, a Polish-American scientist, proposed a system called "general semantics." The basic postulates state that (1) words are not to be confused with things; (2) words can never say all about anything; and (3) words about words about words, and so on, can go on indefinitely. S. I. HAYAKAWA

See also DICTIONARY; LINGUISTICS.

SEMAPHORE, *SEM uh fohr*, is a method of signaling with targets or flags. Each target position has a meaning that trained persons can interpret. Switch mechanisms of railroad signals have semaphore targets that indicate to trainmen how switches are set.

The Semaphore Code makes use of two flags for sending messages. The sender holds the flags in various positions to represent the letters of the alphabet and other signals. The first 10 letters of the alphabet, preceded by the numeral signal, become the numbers 1 to 0. Punctuation marks must be spelled out.



The U.S. Navy uses semaphore flags for short-range signaling. Messages are sent by two flags, each of which has two colors. Boy Scouts once learned how to send messages with semaphore flags. CHARLES B. MACDONALD

See also FLAG (picture: Flags That Talk); RAILROAD (Traffic Control); SIGNALING (Methods of Signaling).

SEMARANG, *suh MAH rahng* (pop. 646,590), is a port located in north-central Java. It has textile, machinery, glass, shoe, and electrical equipment industries. For the location of Semarang, see INDONESIA (color map).

SEMELE, *SEM uh lee*, was the lovely daughter of King Cadmus of Thebes in Greek mythology. Zeus changed himself into a man because he wanted to marry her. His wife Hera became jealous. She disguised herself, and persuaded Semele to ask Zeus to appear as a god. Semele made Zeus promise to grant her desire, and then told him what it was. Zeus begged Semele not to ask him, but she did.

At last he appeared before her as a god. Semele was burned to death at the sight. Zeus saved their son Dionysus from being killed in the fire, and made him immortal (see DIONYSUS). JAMES F. CRONIN

SEMENOV, *SUM uh nuf*, **NIKOLAI N.** (1896-), a Russian scientist, shared the 1956 Nobel prize in chemistry with Sir Cyril Hinshelwood. Semenov wrote many publications based on his research work in chemical kinetics and chemical reactions that release large amounts of energy. He proposed theories to account for the mechanism of many complex chain reactions. He was born in Saratov, Russia. PAUL R. FREY

SEMICIRCULAR CANAL. See EAR (The Inner Ear).

SEMICOLON. See PUNCTUATION.

SEMICONDUCTOR is a material that conducts electricity better than insulators like glass, but not as well as conductors like copper. Such materials have made possible important electronic devices. The *transistors* used in tiny pocket radios are semiconductor devices. So are the *solar batteries* that provide electric power in artificial satellites. Germanium and silicon are the two most widely used semiconductor materials. Other semiconductor materials include cuprous oxide, gallium arsenide, gallium phosphide, lead sulfide, selenium, and silicon carbide.

Electronic devices made of semiconductor materials can perform many functions, including those of vacuum and gas-filled tubes. However, semiconductor devices have a number of advantages over these tubes. Semiconductor devices use much less power than tubes, they last longer, and they can be built much smaller. Some semiconductor devices are smaller than a pinhead.

Like tubes, semiconductor devices can *rectify* (change alternating current to direct current). They can also amplify weak electric signals. In addition, these devices can *oscillate* (make alternating current or radio waves) at frequencies from a few hertz to over 100,000 megahertz. Radios, television sets and other electronic devices depend on rectifiers, amplifiers, and oscillators. Some semiconductor devices can make light, and others can detect light. Many television camera tubes are semiconductor devices.

Basic Principles. In ordinary copper wire, the copper atoms have electrons that are free to move from atom to atom. Such a flow of electrons makes up an electric current. In an ideal state, semiconductor materials would be insulators because they would have no free electrons. But if very small amounts of certain impurities such as antimony, arsenic or phosphorus are present, a few free electrons are produced that can move and form an electric current. These semiconductors are known as *n-type* semiconductors.

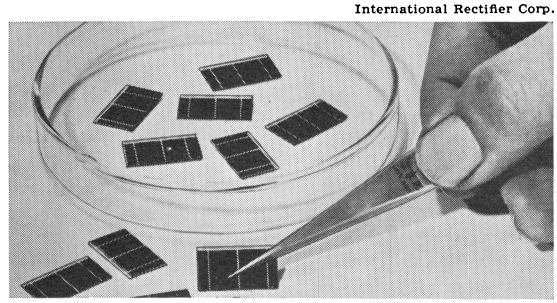
Another type of semiconductor, called *p-type*, is formed by adding small quantities of other impurities such as aluminum, boron, or gallium. These impurities take electrons away from a few atoms of the semiconductor. This lack of an electron in an atom is called a *hole*. A hole can pass from one atom to another. A flow of such holes passing from atom to atom also forms an electric current.

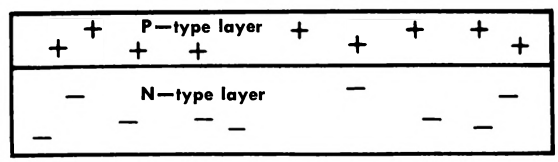
The abbreviation *n* means *negative*, referring to the negative charge of the electrons in n-type materials. Similarly, *p* means *positive*, referring to the positive charge associated with holes in p-type materials.

Semiconductor materials must be exceptionally pure to work properly. Scientists have developed special techniques to obtain pure crystals of semiconductor materials and to add the right amounts of impurities.

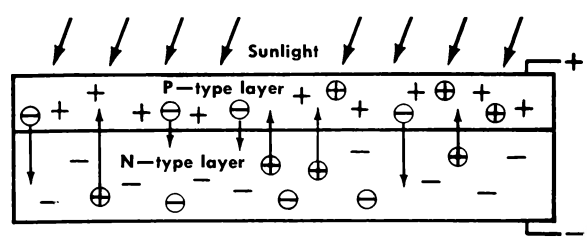
Semiconductor Devices include semiconductor diodes, semiconductor lamps, semiconductor lasers, solar batteries, and transistors. These devices are formed by making certain regions in a semiconductor either p- or n-type.

Semiconductor Solar Cells Turn Light into Electricity.
International Rectifier Corp.





A silicon cell consists of two layers of silicon joined together. An electric field keeps *holes* (positive charges) in the p-type layer and *electrons* (negative charges) in the n-type layer, above. Sunlight produces additional charges (circles, below) that are driven into the positive and negative layers by the electric field. These charges flow out of the cell as an electric current.



Semiconductor Diodes allow current to flow in only one direction, and are used as rectifiers. They have a piece of gallium phosphide, germanium, or silicon with an n-type region and a p-type region. The area where the two regions touch is called a *p-n junction.* When the p-type region has a positive charge and the n-type region has a negative charge, the p-type attracts electrons from the n-type and the n-type attracts holes from the p-type. Thus, electric current flows across the p-n junction. If the p-type region is made negative and the n-type region is positive, almost no current will flow across the junction. The p-type then repels electrons in the n-type, and the n-type repels holes in the p-type.

Other semiconductor diodes, such as the Esaki or tunnel, Gunn, IMPATT, and LSA diodes can oscillate. They generate extremely high frequency radio waves used for communications, radar, or other purposes.

Semiconductor Lamps are tiny gallium phosphide diodes that produce light with little electric power. These lamps are used in some telephone sets.

Semiconductor Lasers produce narrow beams of intense light. They are efficient lasers, but their light covers a wider frequency range than the light from other lasers.

Solar Batteries change sunlight into electricity. They are made of slabs of silicon with a p-n junction near the surface. Light knocks electrons out of the atoms, producing electrons and holes that flow to make an electric current.

Transistors have more than one p-n junction. Many types are used to amplify electrical signals or to oscillate.

JOHN ROBINSON PIERCE

Critically reviewed by WILLIAM SHOCKLEY

See also ELECTRONICS (Solid State Devices); LASER; SOLID STATE PHYSICS; SOLAR ENERGY (Capturing Solar Energy); TRANSISTOR.

SEMILUNAR VALVE. See HEART (Parts of the Heart; How the Heart Works; color picture).

SEMINARY, *SEHM uh NEHR ee,* is a school for training clergymen. It is also called a *theological seminary.* Most religions have seminaries of some kind. Seminary students usually take comprehensive courses in the doctrines, history, philosophy, and sacred writings of their religion. Many also study practical subjects, such as pastoral psychology, and academic subjects.

SEMINARY OF OUR LADY OF PROVIDENCE. See UNIVERSITIES AND COLLEGES (table).

SEMINARY OF SAINT PIUS X. See UNIVERSITIES AND COLLEGES (table).

SEMINARY OF SAINT VINCENT DE PAUL. See UNIVERSITIES AND COLLEGES (table).

SEMINOLE INDIANS, *SEHM uh nohl,* fought to keep their lands in Florida during the early 1800's. They opposed United States government troops sent to force them west to Indian Territory (now Oklahoma).

The Seminole originally belonged to the Creek confederation of tribes, and lived in what are now Alabama and Georgia (see CREEK INDIANS). But, in the early 1700's, they moved into Florida, then owned by the Spanish. They became known as *Seminole,* meaning *runaways.* The English took Florida in 1763, and often incited the Seminole against American settlers. Negro slaves who escaped from their masters sometimes found safety with the Seminole. For these reasons, American forces under Andrew Jackson invaded Florida in 1818. This first Seminole War ended in defeat for the Seminole in that year.

The United States bought Florida in 1819, and began urging the Indians there to sell their lands and move to Indian Territory along with other southeastern tribes. Some Seminole leaders signed a treaty in 1832, and part of the tribe moved. They became one of the Five Civilized Tribes (see FIVE CIVILIZED TRIBES). But other members of the tribe refused to recognize the treaty, and fled into the Florida swamps. The Second Seminole War, fought to force the Seminole west, began in 1835 and lasted for seven years. It cost the United States 1,500 men and more than $20 million. Osceola led the Seminole until he was tricked into discussing peace terms under a flag of truce with General Thomas Jesup. Instead, Jesup seized and imprisoned the Seminole Indian chief, who died in prison in 1838 (see OSCEOLA). Although many of the Indians finally agreed to move west to join their fellow tribesmen in Indian Territory, a small group remained in the Everglades in Florida. In 1970, the Indian Claims Commission awarded the Seminole Indians $12,347,500 for the land taken away from them by U.S. military forces.

Today, most Seminole have small farms in Oklahoma, and live like their white neighbors. The few hundred who stayed in Florida make a living as hunters, fishermen, farmers, cattlemen, and curio sellers. They live in palm-thatched *chickees.* These open huts stand on platforms raised above the ground (see INDIAN, AMERICAN [picture: The Seminoles]). Many of the Seminole still dress in cotton clothes based on Spanish costumes of the 1700's.

WILLIAM H. GILBERT

See also FLORIDA (Territorial Days; color picture: Seminole Indians Branding a Calf).

Seminole Women in Florida wear their traditional tribal costumes, but the men usually wear ordinary work clothes.

Jos. J. Steinmetz, Publix

SEMINOLE WARS. See FLORIDA (Territorial Days); INDIAN WARS (In the South); MONROE, JAMES (War with the Seminole).

SEMIRAMIS, *sih MIHR uh mihs,* was the name of a mythical queen of Assyria. She supposedly founded the ancient city of Babylon, and conquered Persia (Iran) and Egypt.

Semiramis was the daughter of a Syrian youth and a fish goddess. Her mother left her, and she was fed by doves. Semiramis grew to be a beautiful woman and married King Ninus of Assyria. She became queen when he died, and won many battles, but her son overthrew her. Herodotus mentions a Semiramis who was queen of Babylon in the 700's B.C. PADRAIC COLUM

SEMITE, *SEM ite,* is a member of a group that speaks one of the Semitic languages. The ancient Hebrews, Assyrians, Phoenicians, and Carthaginians were Semites. The Arabs and some Ethiopians are present-day Semitic-speaking peoples.

Semitic peoples gave the world the idea of One God. They started three great religions, Judaism, Christianity, and Islam, the religion of the Moslems. The world also is indebted to a Semitic people—the Phoenicians—for developing and simplifying the alphabet. The greatest literary achievements of the Semites are the Bible; the Talmud, or code of Jewish law; and the Koran, the sacred book of the Moslems.

Most Semitic-speaking peoples are of the Mediterranean race. Jews were once a subtype of this race, but they have mixed with other peoples until the name Jew has lost all racial meaning. Hebrew, which is the traditional language of the Jews, is a Semitic language, and Jews are sometimes called Semites. The term *anti-Semitism* (hatred of the Jews) comes from this name.

The so-called "Semitic nose" is a trait inherited from people who lived in Armenia and the Iranian Plateau. Typical present-day Semites include such peoples as the Bedouins of Northern Arabia and the Himyarites of South Arabia. WILTON MARION KROGMAN

Related Articles in WORLD BOOK include:

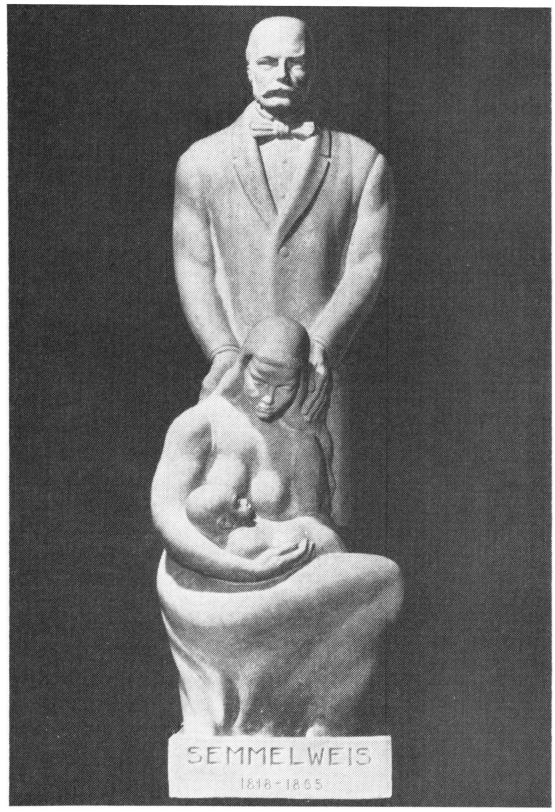
Assyria	Jews
Bedouins	Judaism
Carthage	Phoenicia
Hebrew Language and Literature	Semitic Language

SEMITIC LANGUAGE. The Semitic languages are very old. They are now spoken mainly in Arabia, Palestine, Syria, and Iraq, and in Egypt and the other North African countries. The Semitic languages include Assyrian, Aramaic, Syrian, Canaanitic, Phoenician, Hebrew, Arabic, and Ethiopic. The Aramaic language was spoken by Jesus.

People who spoke the Semitic languages are supposed to have been the first to develop a true alphabet. Their languages are among those which have the longest recorded history. Of the ancient Semitic languages, Hebrew is the only one that has survived as a spoken language. The Assyrian and Babylonian languages have been preserved extensively as literary monuments of the past. They were written in wedge-shaped characters known as *cuneiform.* LEONARD C. MISHKIN

See also ALPHABET; ARABIC LANGUAGE; ARAMAIC; CUNEIFORM; HEBREW LANGUAGE AND LITERATURE; SEMITE.

SEMLIKI RIVER. See LAKE EDWARD.



International College of Surgeons, Chicago

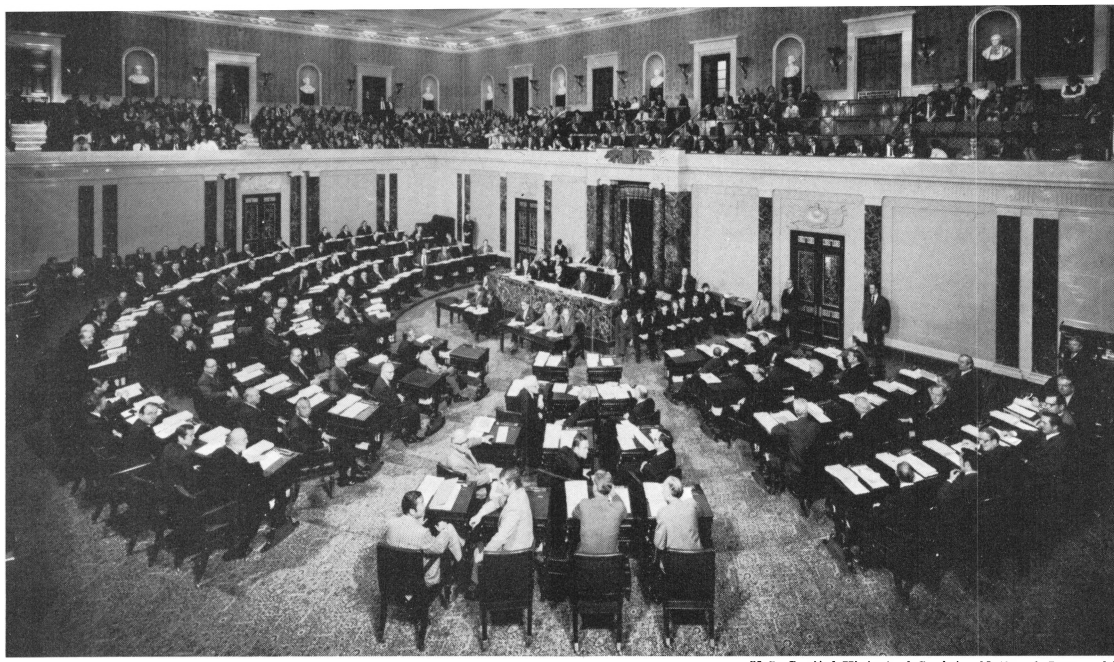
Ignaz Semmelweis, Hungarian physician, pioneered in the use of antiseptic methods in childbirth. This sculpture by Edouard Chassaing stands in the Hall of Immortals in Chicago.

SEMMELWEIS, *ZEM ul vise,* **IGNAZ PHILIPP** (1818-1865), was a Hungarian doctor who first used antiseptic methods extensively in childbirth. At the Vienna General Hospital, he discovered that puerperal fever, which then killed about 12 mothers out of every 100, was contagious, and that doctors themselves were spreading the disease by not cleaning their hands. He was ridiculed for this idea. But he maintained his stand, and in 1860 published his classic work on *The Etiology, Concept and Prophylaxis of Childbirth Fever.*

Opponents of his ideas attacked him fiercely. This battle eventually brought on a mental illness. The year of Semmelweis' death, Joseph Lister performed his first antiseptic operation, and soon afterward it was recognized that Semmelweis had been right. Semmelweis was born in Budapest. GEORGE ROSEN

SEMMES, *semz,* **RAPHAEL** (1809-1877), a rear admiral in the Confederate Navy, commanded the famous ship *Alabama* in the Civil War. When the *Alabama* was sunk off Cherbourg, France, an English yacht rescued Semmes and took him to England. He returned home and took command of the James River squadron, which he had to destroy during the evacuation of Richmond. Semmes organized his men into a land force, but later surrendered at Greensboro, N.C. He was born on Sept. 27, 1809, in Charles County, Maryland. He joined the Navy when he was about 17. After the Civil War, Semmes practiced law in Mobile, Ala. See also ALABAMA (ship). RICHARD S. WEST, JR.

SEMPACH, BATTLE OF. See WINKELRIED, ARNOLD VON.



U.S. Capitol Historical Society (National Geographic)

The Senate Chamber of the United States Capitol has a gallery for reporters and other visitors observing the action on the floor below. The Senate usually prohibits the use of cameras in the chamber, but special permission was given for this official photograph.

SENATE is the upper and usually smaller house of a *bicameral* (two-house) national legislature in some countries. Such countries as Australia, Canada, France, Ireland, Italy, South Africa, and the United States have senates. The upper houses of state legislatures in the United States are also called *senates.* Most state senates convene every two years.

The senate takes part with the lower house in making laws. It may have only a minor role, as in Ireland, where the Senate serves mainly as an advisory body to the lower house. But it may have a considerable part in lawmaking, as in the United States, where all laws must have the approval of the Senate. The Senate of the United States can initiate any law, except those dealing with revenue. It alone has power to confirm treaties and the President's nominations for major federal offices.

The Romans established the first senate. The Roman Senate had about 300 to 600 wealthy and prominent men as members. During the Roman Republic, it became one of the most important organs of government (see ROMAN EMPIRE [The Republic]). Modern senates were set up as a check on the more democratic lower houses. They were considered the superior branch of the legislature, because of their prestige, power, and lack of direct control by the voters. The Senate of the United States now is the only upper house of a national legislature with greater prestige than the lower house.

The United States Senate

The Constitutional Convention of 1787 reached a deadlock over the problem of representation in Congress. The delegates from the small states insisted on equal representation for each state. Those from the large states wanted representation according to population. A compromise provided for two representatives for each state regardless of population in the Senate, and for representation according to population in the House of Representatives. The Senate now has 100 members.

Qualifications. The Constitution provides that a senator must be: (1) at least 30 years old, (2) a citizen of the United States for nine years, and (3) a resident of the state from which he is elected. It also provides that senators should receive some payment for their services. Each senator now receives $42,500 a year. He receives an office in one of the Senate office buildings, and allowances for travel, office upkeep, secretaries' salaries, and similar expenses. The Constitution protects senators from arrest for anything that they say or write in Congress in connection with the business of the Senate. This guarantee frees the senators from fear of offending someone by what they might say.

Organization. Senators are elected for six-year terms. Only about one-third of the senators are elected at any one time. This prevents a complete turnover in the Senate. The more experienced senators manage the affairs of the Senate until they can train the new ones.

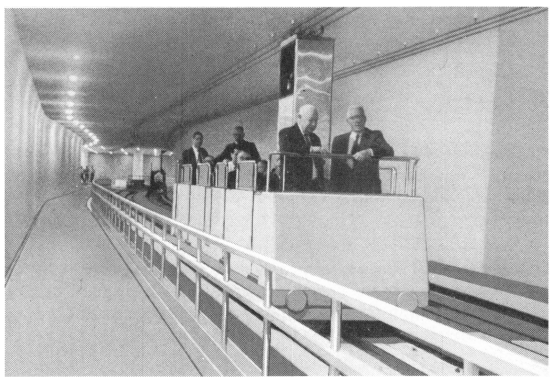
The Vice-President of the United States presides over the Senate. He is not a member of the Senate and votes only in case of a tie. The Senate selects a *president pro tempore*, or temporary president, who presides during the absence of the Vice-President.

The Senate carries on much of its work by means of committees. It has 18 *standing* (permanent) committees, handling aeronautical and space sciences, agriculture, appropriations, armed services, banking, budget, finance, foreign relations, government operations, interior affairs, interstate and foreign commerce, judiciary, labor, post office and civil service, public works, rules, veterans' affairs, and the District of Columbia. It also has special committees, and joint committees with the House.

The Senate elects the members of the committees. But the party *caucuses* (meetings) actually decide committee assignments before the formal elections. Both

United Press Int.

Senate Committees Hold Hearings to gather information about proposed laws. The committees then decide whether to recommend Senate approval of the bills. Senator John F. Kennedy, *third from right,* served on the Senate Labor Rackets Committee. His brother Robert, *fourth from right,* was the group's counsel.



Wide World

An Electric Subway Train carries senators, their assistants, and visitors between the Everett McKinley Dirksen Office Building and the Capitol. This subway line is about 2 blocks long.

Library of Congress

The Senate Wing of the Capitol, *right,* includes the Senate Chamber, committee rooms, and various offices. The House of Representatives meets in the other wing of the Capitol.

parties are represented on each committee. But the majority party in the Senate has more members on any one committee than the minority party. Committee chairmanship and rank are based on *seniority,* or the number of years of service on a particular committee.

Senators can debate an issue indefinitely, unless they agree to limit discussion. The practice of carrying on unlimited debate in order to block legislation is known as *filibustering* (see also FILIBUSTERING). A move to limit debate, called *cloture,* requires a vote of 60 senators, three-fifths of the Senate's membership, on most bills.

Executive Functions. The framers of the Constitution intended the Senate to serve as an advisory council to the President. The Constitution states that the *ratification,* or approval, of treaties requires the "advice and consent" of two-thirds of the senators present. The President nominates more than 25,000 federal officers with the approval of the Senate. These include some of the most important positions in the executive branch of the government. Senators of the President's own party usually suggest candidates in their home states for federal positions. Under the custom called *senatorial courtesy,* the Senate usually refuses to confirm nominations made without the approval of the senators from the state where the candidate lives.

Representation. Each state, regardless of population, is equally represented in the Senate. Some people criticize this practice, because senators who represent only a minority of the population can stop legislation that the majority wants. The Senate is also criticized as representing an overweighted rural population. But, in some ways, the Senate represents urban and industrial populations better than the House does. In a senatorial election, every city vote is equal to every rural vote.

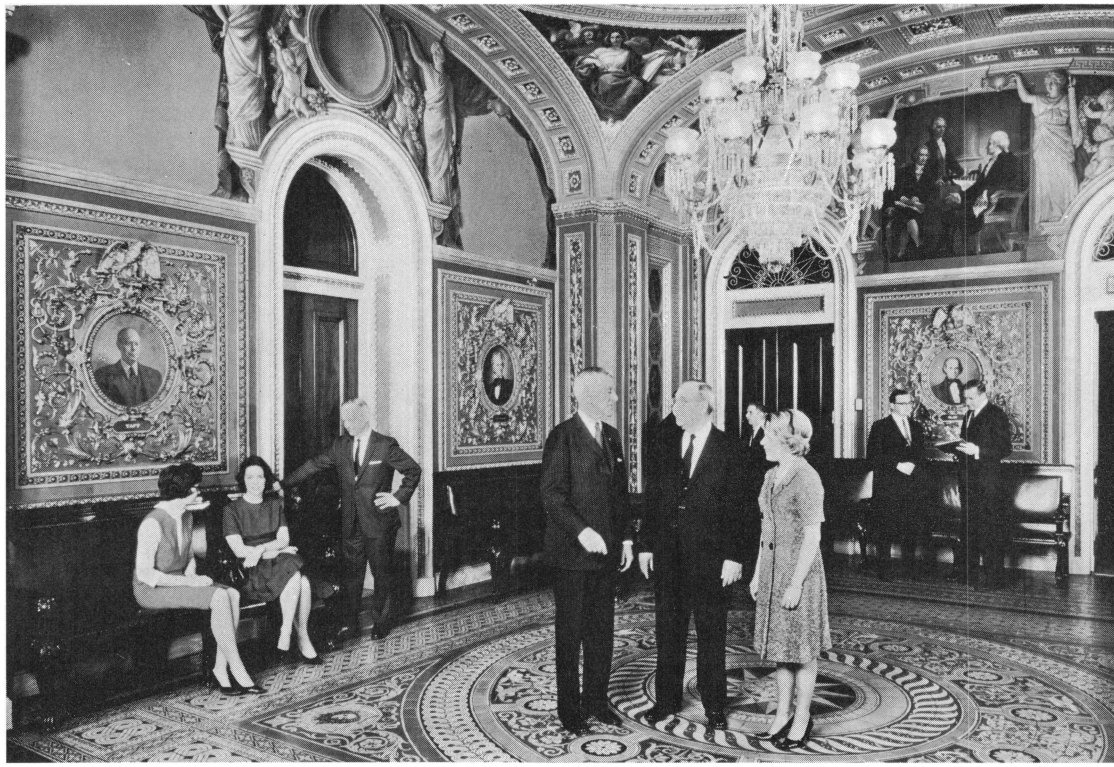
Prestige of the Senate. Senators usually have great influence in their own states, and they are often persons of outstanding ability. Their six-year term of office provides them much independence. They do not have to think constantly about re-election. Senate rules are more flexible than those in the House. Full debate is permitted, and senators are not seriously checked by their leaders. This allows them time and freedom to analyze and discuss problems. In 1963, the Senate gave former U.S. Presidents the right to speak on the Senate floor after notifying the presiding officer.

Portraits of John C. Calhoun; Henry Clay; Robert M. La Follette, Sr.; Robert A. Taft; and Daniel Webster hang in the reception room off the Senate Chamber in the Capitol. The Senate chose these men for its Hall of Fame because they "left a permanent mark on our nation's history and brought distinction to the Senate."

Senates in Other Countries

The senates in some countries, such as Canada and Ireland, are not elected directly by the people. In Canada, the *governor general in council* (the governor general with the advice of the prime minister and the cabinet) appoints senators for life terms. In Ireland, the prime minister appoints 11 of the 60 senators. Two universities appoint six members, and the rest are appointed by various occupational groups.

Voters in Italy elect members of the Senate. Representation is based on population, with one senator

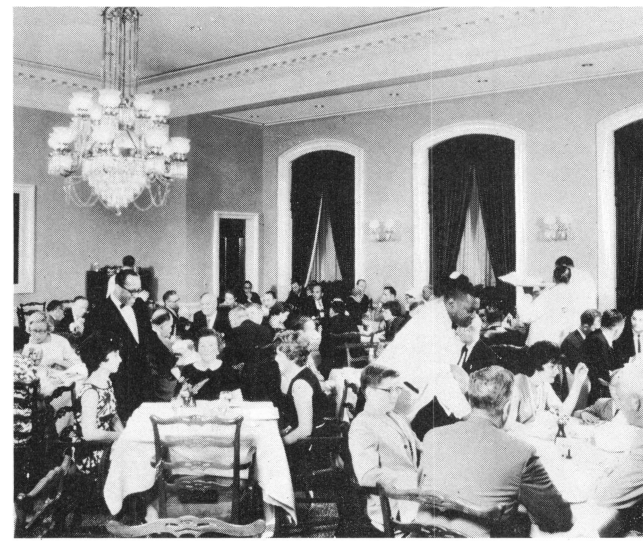


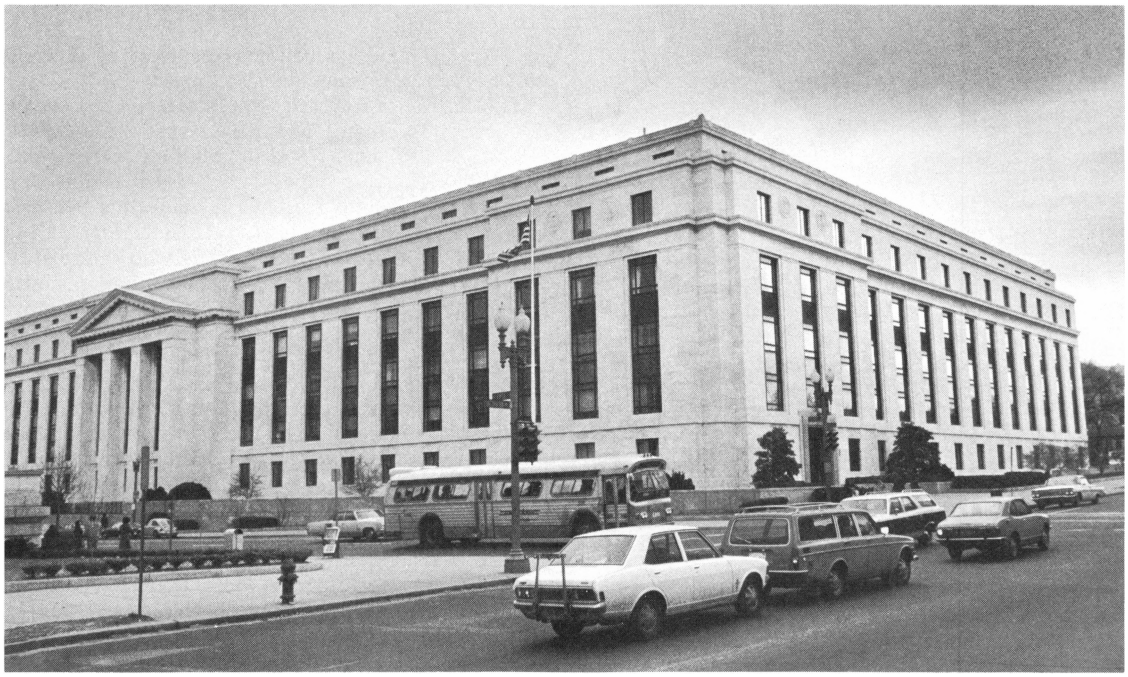
The Senate Reception Room, *above,* is where senators greet guests. It has portraits of Senators John Calhoun, Henry Clay, Robert La Follette, Robert Taft, and Daniel Webster.

Congressional Pages, *left,* carry messages and run errands for members of the Senate and the House. To be a page, a boy or girl must be a high school student with good grades. The pages attend a special school in the Library of Congress.

The Senate Restaurant, *below,* is open only to senators and their guests. The restaurant is famous for its Senate Bean Soup and flaky apple pie which are daily menu items.

All photos courtesy of the U.S. Capitol Historical Society





Paul Conklin

The Everett McKinley Dirksen Office Building includes offices and committee rooms used by United States senators. The building, which stands near the Capitol, was completed in 1959.

elected for every 200,000 persons. Many Latin-American countries, such as Argentina and Brazil, have senates modeled after the Senate of the United States.

The French Third Republic had a Senate. Under the Fourth Republic, the upper house was called the Council of the Republic. The constitution of the Fifth Republic, adopted in 1958, provided for a Senate elected indirectly. Regional and municipal electors in France choose most of the senators. Overseas departments and territories elect the others. WILLIAM G. CARLETON

Related Articles. See the Government sections of the articles on each country mentioned, such as IRELAND (Government); also the Legislature section of each state article, such as OHIO (Legislature). Other related articles in WORLD BOOK include:

Address, Form of	Impeachment
Canada, Government of (The Senate)	Parliament
Cloture	Senator
Congress of the U.S.	State Government (Legislative Branch)
Constitution of the U.S.	United States, Government of the
Filibustering	Vice-President of the U.S.
House of Representatives	

SENATOR is a name given to a member of the United States Senate or a state senate. It also refers to national representatives in other countries. See also ADDRESS, FORM OF.

SENATORIAL COURTESY. See SENATE (Executive Functions).

SENDAI, *SEN dye* (pop. 545,065), is the largest city in northeastern Japan. For location, see JAPAN (political map). Founded in the 1500's, the city now serves as a manufacturing and cultural center. Products include foodstuffs, chemicals, metal goods, and silk yarns. Tohoku University is located there.

SENDAK, MAURICE (1928-), is an American illustrator and writer of children's books. He won the Caldecott medal in 1964 for his illustrations in *Where the Wild Things Are* (1963), which he also wrote. His first published illustrations appeared in *The Wonderful Farm* (1951) and *A Hole Is To Dig* (1952). He wrote and illustrated *Kenny's Window* (1956), *Very Far Away* (1957), and *The Sign on Rosie's Door* (1960). Sendak was born in Brooklyn.

SENECA, LUCIUS ANNAEUS (4 B.C.?-65 A.D.), was a Roman statesman, author, and Stoic philosopher. His surviving works include 12 philosophic essays, 124 letters, a meteorological essay, a satire, and 9 tragedies. His tragedies adapt subjects used by the Greek playwrights. But they are intense, violent melodramas full of rhetorical language. They focus on the Stoic belief that catastrophe results when passion destroys reason. The plays widely influenced tragic drama in Italy, France, and Elizabethan England.

Seneca was born in Spain into a distinguished Roman family. He became prominent in political and literary life in Rome. Later he became the tutor and adviser of the Emperor Nero. Nero accused Seneca of plotting his death, and forced him to commit suicide. NORMAN T. PRATT

See also GEOLOGY (The Romans).

SENECA INDIANS. See IROQUOIS INDIANS.

SENECA LAKE. See FINGER LAKES.

SENEFELDER, *ZAY nuh FEL der,* **ALOIS** (1771-1834), invented the process of lithography (see LITHOGRAPHY). As a young man, Senefelder wrote plays. Because he could not get them published, he tried to print them himself. While preparing to etch a stone slab, he wrote on it with a wax crayon and found that the marks could be inked and printed. He was born in Munich.

SENEGAL

WORLD BOOK map

SENEGAL, *sehn uh GAWL,* is farther west than any country in Africa. It lies at the tip of the great bulge of Africa that sticks westward into the Atlantic Ocean. Dakar is the capital and largest city of Senegal.

Senegal is slightly smaller than the state of Nebraska, but it has almost three times as many people. It is cut almost in two by the tiny nation of Gambia. A road through Gambia links the northern part of Senegal with the southern part, called the *Casamance.* The country takes its name from the Sénégal River, which forms the northern boundary with Mauritania.

France ruled what is now Senegal before the African nation gained independence in 1960. French is still the official language and the country's official name in French is RÉPUBLIQUE DU SÉNÉGAL.

Government. Senegal is a republic. The people elect the president to a five-year term. He serves as head of state and chief executive. He appoints a prime minister to assist him. The National Assembly, the lawmaking body, has 80 members elected to five-year terms.

People. Senegal has a population of 4,532,000. Most of the people are Negro Africans. About 8 out of 10 are Moslems, and many of the rest are Christians.

Senegal has a rigid caste system that plays an important part in the lives of the people. The caste system divides the people into five groups. These are: (1) nobles, (2) freeborn, (3) *artisans* (skilled workmen), (4) *griots* (musicians and praise singers), and (5) former slaves and their descendants. Members of different tribes often marry. But marriage between members of different castes is extremely rare. See also CASTE.

The six major tribes in Senegal are the (1) Wolof; (2) Serer; (3) Fulani, also called the *Peul* or *Fula;* (4) Tucolor; (5) Diola; and (6) Malinke. Over a million Wolof tribesmen live in the coastal region from Saint-Louis to Gambia. About 600,000 Serer live next to the Wolof, and are closely related to them. Most of the Wolof and Serer are farmers who raise cattle, goats, and sheep, and crops of millet and peanuts.

More than 200,000 Fulani live as nomads who graze their herds mainly in a dry area in the north and east called the *Ferlo.* Most of the more than 400,000 Tucolor tribesmen live along the valley of the Sénégal River. They are closely related to the Fulani. The Diola, the largest tribe in the Casamance, are the leading rice growers. Most of the more than 200,000 Diola practice tribal religions, but some are Moslems. There are about 200,000 Malinke. Most are farmers and traders who live in the southeast. See FULANI; MALINKE.

Most of the older people in Senegal cannot read or write. But the government is trying to make education available to as many people as possible. About 4 out of 10 children attend schools. The University of Dakar has a fine medical school.

Land. Senegal covers an area of 75,750 square miles (196,192 square kilometers) and has a 310-mile (499-kilometer) coastline along the Atlantic Ocean. Most of the people live in three main areas—(1) the Sénégal River Valley; (2) the coastal region, where fishing is among the best in Africa; and (3) the region east and south of Dakar, watered by such major rivers as the Sine, Saloum, Gambie, and Casamance. The Ferlo, a large area in the northern and eastern sections of Senegal, is extremely dry. Parts of the Ferlo are semidesert.

The coastal areas have a pleasant climate for about nine months of the year. Inland areas are very hot most of the year. Rainfall varies sharply in different parts of the country. Ziguinchor, in the Casamance, has an average rainfall of 64 inches (163 centimeters) a year. Podor, in the extreme northern part of the coun-

Keith G. Mather, the contributor of this article, is a British expert on Africa and the Middle East. He has lived and traveled in Africa, and written extensively on African countries.

FACTS IN BRIEF

Capital: Dakar.

Official Language: French.

Official Name: Republic of Senegal.

Form of Government: Republic. *Head of State*—President.

Area: 75,750 sq. mi. (196,192 km²). *Coastline*—310 mi. (499 km).

Population: *Estimated 1976 Population*—4,532,000; distribution, 72 per cent rural, 28 per cent urban; density, 60 persons per sq. mi. (23 persons per km²). *1960-1961 Census*—3,109,840. *Estimated 1981 Population*—5,103,000.

Chief Products: *Agriculture*—beans, cassava, corn, livestock (cattle, goats, sheep), millet, peanuts, potatoes, rice, sorghum, sweet potatoes. *Mining*—phosphates, zirconium. *Fishing*—tuna. *Manufacturing and Processing*—beer, cement, cotton goods, peanut products.

Flag: The flag has green, gold, and red vertical stripes. A green star lies in the center of the gold stripe. See FLAG (color picture: Flags of Africa).

Money: *Basic Unit*—franc. See MONEY (table: Values).

try, averages only 12 inches (30 centimeters) a year.

Economy. Senegal's economy is based mainly on its peanut crop. The country produces about 900,000 short tons (820,000 metric tons) of peanuts a year. Peanuts, peanut products, and phosphates are the main exports. Fishing is an important industry in the coastal areas and near the rivers. Some fish canneries on the Cape Verde Peninsula export to France and other countries. Dakar is one of the most important industrial centers in western Africa. Miners in western Senegal dig large quantities of phosphates.

Senegal has about 8,700 miles (14,000 kilometers) of roads, but most of them are dirt roads or trails. The most important railroad is the 769-mile (1,238-kilometer) rail line that links Dakar with Bamako, the capital of Mali. Dakar is an important stop on air routes between Europe and South America, and between the United States and Africa. It is also one of western Africa's major seaports.

History. In ancient times, Senegal was the site of many important kingdoms. Many of the kingdoms became part of the Sudanic empire of Ghana, which flourished from the A.D. 700's to the 1000's. Parts of what is now Senegal were under the Mali empire during the 1300's, and the Songhai empire during the 1500's. In the 1700's, Fonta Toro, a militant Islamic state, ruled in the Sénégal River Valley.

Portuguese sailors, the first Europeans to visit the region, reached the Cape Verde Peninsula in the 1400's. They established a settlement at Gorée, a small island off Dakar. France took over Gorée in the 1600's, and also established a settlement in Saint-Louis, at the mouth of the Sénégal River. During this period, Dutch, English, and French traders bought slaves along the coast of Senegal. General Faidherbe became governor of Senegal in 1854. He extended French control in the area, and all of what is now Senegal was under French control by 1895. Senegal then became the headquarters of the French West African Federation.

In 1946, Senegal became a territory in the French Union and elected two deputies to the French National Assembly. It became self-governing within the French Community in 1958. In 1959, Senegal and French Sudan (now Mali) formed the Federation of Mali. But Senegal withdrew in 1960, and became an independent republic. Léopold-Sédar Senghor became Senegal's first president.

Prime Minister Mamadou Dia was arrested for attempting to overthrow the president in 1962. Prime Minister Dia and others were tried, convicted, and imprisoned in 1963. Senegal then adopted a new constitution, giving the president executive authority. In 1966, the first World Festival of Negro Arts was held in Dakar. In the early 1970's, Senegal's economy was severely disrupted by a long period of drought in the eastern part of the country. The drought caused widespread food shortages and other problems. KEITH G. MATHER

See also CAPE VERDE; DAKAR; FRENCH WEST AFRICA; SENGHOR, LÉOPOLD-SÉDAR.

SENGHOR, LÉOPOLD-SÉDAR (1906-), was elected the first president of Senegal in 1960. He is a world-famous poet and a leading African thinker.

Senghor was born in Joal, Senegal, in French West Africa, and graduated from the Sorbonne in Paris. In 1948, he founded the party which governs Senegal. Before Senegal gained independence in 1960, Senghor represented the colony in the French National Assembly. He was the first African to hold a seat in the French Cabinet. Senghor unsuccessfully urged France to grant independence to its west and central African colonies as a group. IMMANUEL WALLERSTEIN

SENILITY is one of the last steps in the process called *aging*. Senility results when aging causes a fading memory and body defects. Hardening of the blood vessels is one of the major changes in senility. The hardening narrows the blood vessels, the blood supply diminishes, and many organs cannot work as they should.

Senility occurs later in some persons than in others. But those who become senile usually reach this stage after about 65 years of age. They first go through *senescence*, a period when the body ages without becoming weak. See GERIATRICS. LOUIS D. BOSHES

SENLAC. See HASTINGS, BATTLE OF.

SENNA. See CASSIA.

SENNACHERIB, *suh NAK ur ihb* (reigned 704-681 B.C.), was king of Assyria, in what is now northern Iraq. He ruled the Assyrian Empire in a period of revolt and war, and fought a long series of battles against Babylonia and its allies from Elam, in what is now Iran.

Sennacherib succeeded his father, Sargon II, as king. In 703 B.C., he ended a revolt of the Babylonians and Elamites led by Merodachbaladan. Merodachbaladan had been king of Babylonia until defeated by Sargon and was trying to regain his throne. Cities in Syria and Palestine revolted in 701 B.C. Sennacherib regained all except Jerusalem. He crushed a revolt in Babylonia in 689 B.C., and destroyed the city of Babylon as a warning to other rebels. He made Nineveh Assyria's capital and built a city there. In 681 B.C., his sons murdered him. Esarhaddon, a son who claimed to be innocent of the murder, became king. JACOB J. FINKELSTEIN

See also LIBRARY (Libraries of Clay).

SENNETT, MACK (1884-1960), was a pioneer motion-picture director and producer who became famous for his slapstick silent comedies. Almost every silent comedy star worked for him. Sennett's topsy-turvy film world rejected the logical values of everyday life. His famous Keystone Cops seldom arrested anyone. When they did, it was the wrong man. Sennett's bathing beauties fell in love with fat elderly gentlemen instead of youthful suitors. These and other characters were involved in famous chases that climaxed most Sennett films. The chases ended in violent catastrophes in which nobody got hurt. Sennett was born in Danville, Que. His real name was Michael Sinnott. He directed about 1,000 silent films, beginning in 1910. His career came to a virtual end soon after the arrival of sound films in the late 1920's. RICHARD GRIFFITH

See also MOTION PICTURE (History; picture).

SENSATION. See SENSES.

SENSES are the means by which many-celled animals tell what is happening in their environment. Many people think that human beings have only five senses —hearing, sight, smell, taste, and touch. But scientists have found that human beings also have other kinds of senses that give information about body

needs. These senses include hunger, pain, and thirst.

Scientists divide the senses into two groups. *External senses* receive information about the outside environment—about things outside the body. These senses include hearing, sight, smell, taste, and touch. They also include the sense of heat, which is felt by special *receptor* (receiver) cells in the skin. *Internal senses* receive information about the internal environment—about the organs and tissues of the body.

External Senses. Some external senses detect things that occur far from the body, and others detect things that come in contact with it. We detect things in the distant outside environment with our senses of sight, hearing, and heat. These senses are called *distance receiving senses*. They require only a small stimulus from the environment to respond. For example, the minimum amount of light a person can see—one photon—is also the minimum amount of light that can exist. This high sensitivity is necessary because the stimulus may occur far away. Therefore, the amount of energy that reaches the sense receptor is often very small.

The senses of taste, touch, and smell involve contact with the body and are called *contact external senses*. These senses require a fairly large stimulus to respond. For example, many thousands of molecules of a substance must be present for something to be tasted. Relatively heavy pressure must be applied to the skin for an object to be felt. Because these stimuli occur at the receptors, high sensitivity is not needed.

Internal Senses detect changes that take place inside the body and send messages about these changes to the brain. The internal senses respond to chemical and physical stimuli in the circulatory, digestive, excretory, respiratory, and central nervous systems. They control such feelings as hunger, fatigue, pain, and thirst. The internal senses also respond to the position and movement of the joints, to tension in the muscles, and to the position of the head. By responding to all these chemical and physical changes, the internal senses help maintain a proper internal environment.

The internal senses are highly sensitive to small changes in the amounts of chemicals that are usually present in the body. This high sensitivity is necessary because the internal receptors must maintain a rather constant internal environment for life to continue. The receptors that respond to chemical changes in the internal environment are called *internal chemoreceptors*.

By studying the senses, scientists learn what things in the environment are important to each kind of animal. They also learn something about the environment in which the *evolution* (gradual development) of particular groups of animals occurred.

BRUCE P. HALPERN

Related Articles in WORLD BOOK include:

Animal (The Senses)	Hunger	Nervous System	Smell
Brain	Hyperesthesia	Nose	Taste
Ear	Insect (The Senses)	Pain	Thirst
Eye	Muscle Sense	Perception	Touch
		Sleep	

See also *Senses* in the RESEARCH GUIDE/INDEX, Volume 22, for a *Reading and Study Guide*.

SENSITIVE PLANT is a small, spreading shrub that grows in the tropics of the Western Hemisphere. The plant is called *sensitive* because its small leaflets fold together when touched or exposed to strong fumes. At the same time, the leafstalks bend toward the main stem, as

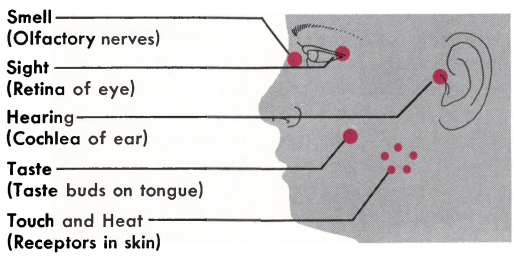
OUR EXTERNAL AND INTERNAL SENSES

Our senses are divided into two main groups. *External senses* tell us about things that occur far from the body and that come in contact with it. *Internal senses* give us information about changes that occur in the tissues and organs inside our bodies.

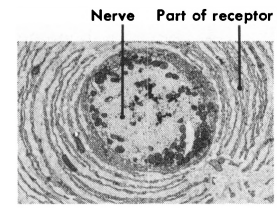
WORLD BOOK diagrams by Mary Ann Olson

External Senses

The external senses of hearing, heat, and sight tell us about things that happen far from the body. The external senses of taste, touch, and smell tell us about things that come in contact with the body. The diagram at the right shows where the receptors of the external senses are located.



External Senses and Their Receptors

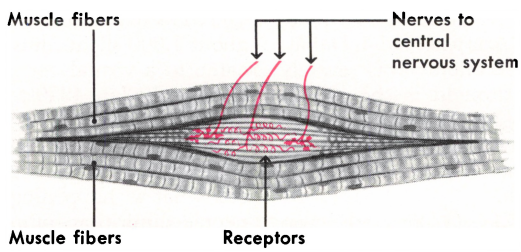


Dr. Y. Ibata

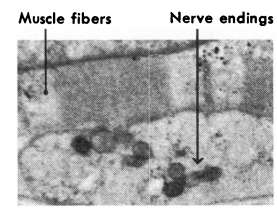
The end of a nerve is magnified 2,000 times above. The nerve leads from a touch receptor.

Internal Senses

The internal senses send messages to the brain about changes that take place inside the body. The senses control such feelings as fatigue, hunger, pain, and thirst. They also respond to tension in the muscles. The diagram at the right shows the receptors that sense tension in muscle fibers.



Receptors of the Internal Sense of Muscular Tension

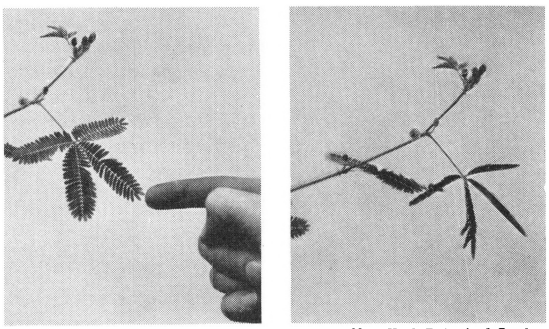


Dr. Arthur Hess

Nerves of a muscle tension receptor, magnified 6,000 times above, connect to muscle fibers.

though the plant were shrinking from being touched.

Sensitive plants are sometimes grown in greenhouses as curiosities. Sensitive briars of the southern United States also close when handled roughly. Leaves of many members of the pea family close at night.



New York Botanical Garden

Leaves of the Sensitive Plant react quickly when they are touched or exposed to strong fumes. After a person touches the leaves with his hand, *left*, the leaves fold up tightly, *right*.

Scientific Classification. The sensitive plant belongs to the pea family, *Leguminosae*. It is classified as genus *Mimosa*, species *M. pudica*. ROBERT W. SCHERY

See also PARTRIDGE PEA; PLANT (picture: The Remarkable Sensitive Plant); TELEGRAPH PLANT.

SENSITIVITY TRAINING is a learning process designed to increase an individual's awareness of himself, other people, and his environment. Sensitivity training takes place in a group of from 8 to 20 persons, including a leader. Members of this *encounter group* speak openly about their feelings and reactions to others in the group. Some group leaders involve members in various *games* to produce strong emotional experiences. These games include such activities as having two members stare into each other's eyes, or having a member act out a feeling of affection or anger.

Some psychologists regard sensitivity training as a major development in their field. They believe it can make a person more aware of his inner feelings and help him get along more effectively with others. Some educators use sensitivity training techniques in teaching. Businessmen have attended encounter groups to learn how to work more productively with others.

Other psychologists criticize sensitivity training. They call it experimental and claim that its effectiveness has not been proved. They declare that many group leaders lack proper training. Such critics also believe that encounter groups do not take enough care to exclude people who might react badly to sensitivity training. They point out that some participants have been physically or psychologically injured at encounter group meetings.

Kurt Lewin, a German psychologist, conducted the first encounter group at an interracial workshop in New Britain, Conn., in 1946. The Esalen Institute in Big Sur, Calif., developed and popularized sensitivity training during the 1960's. ROBERT G. WEYANT

SENSORY NERVE. See NERVOUS SYSTEM (Kinds of Neurons).

SENTENCE is a series of words arranged into a meaningful unit. A sentence begins with a capital letter and ends with a punctuation mark—a period, or question mark, or an exclamation point. A grammatically complete sentence consists of an independent group of words that has a subject and a predicate. The predicate must include a *finite verb*. Such a verb, with a subject, can form a sentence—for example, *He talks* or *The lightning flashed.*

The group of words *The potatoes cooking* has a subject, but it is not grammatically complete because it lacks a finite verb. *The potatoes are cooking* is a grammatically complete sentence because it has a subject and a finite verb. *When the potatoes are cooking* is not a sentence because it is not an independent group of words. The word *when* makes it a subordinate clause instead of a main clause. Sentences must be main clauses. See CLAUSE.

Subject and Predicate. The subject of a sentence consists of a noun or another word used as a noun, plus its modifiers. The subject tells what is being spoken about. In the sentence *The latest issue of the magazine arrived today*, the subject is *issue*. The modifiers are *The*, *latest*, and *of the magazine*. Together, the six words form the *complete subject*. In *Vigorous bicycling is good exercise*, the subject is *bicycling*. Its modifier is *vigorous*. The two words together make up the complete subject.

A predicate consists of a finite verb, along with its object or complement and their modifiers. The finite verb may be transitive, intransitive, or a linking verb. A *transitive* verb passes the action from the subject to a direct or indirect object. The meaning of an object may be completed by a noun or adjective called a *predicate complement*. An *intransitive* verb describes a completed action and needs no object. A *linking verb* connects the subject with a predicate noun, pronoun, or adjective that completes the meaning of the subject and is called a *subjective complement*. See VERB.

As a unit, the predicate tells something about the subject. In *Our class sold homemade cookies*, *sold homemade cookies* says something about the subject *Our class*. The verb is *sold;* the object is *cookies*, and its modifier is *homemade*. Together, they form the *complete predicate*. In *The young boy became very ill*, *became very ill* comments upon the subject *The young boy*. *Became* is the verb; *ill* is the predicate complement, and *very* is its modifier. Together, they form the complete predicate.

A *compound subject* consists of two or more nouns: *Hydrogen and oxygen combine to form water*. A *compound predicate* consists of two or more finite verbs: *Water can be frozen into a solid or can be heated into a gas.*

Sentence Classifications. A sentence can be classified by its purpose. If the purpose of a sentence is to state a fact, it is a *declarative* sentence: *I found a dollar.* If it asks a question, it is an *interrogative* sentence: *Did you find a dollar?* If it gives a command or makes a request, it is an *imperative* sentence: *Lend me a dollar, please.* If it expresses strong feeling, it is an *exclamatory* sentence: *How lucky I was to find a dollar!*

A sentence can also be classified by its grammatical form. A *simple sentence* has one subject and one predicate: *The wind blew fiercely*. But either the subject or the predicate can be compound: *Oranges and lemons are citrus fruits* has a compound subject. *The cat snarled and scratched* has a compound predicate.

SENTENCE

A *compound sentence* joins two or more simple sentences. They are joined with a conjunction, such as *and, but, or, for, nor,* or *yet: I wrote her, but she did not reply.* A *complex sentence* consists of a main clause and one or more subordinate or dependent clauses: *Animals bite when they are teased or when they are attacked.*

Sentence Patterns. The variety of English sentences may be shown by examining how several basic sentence patterns can be changed. Such basic patterns are sometimes called *kernels.*

PATTERN I

Subject	Intransitive Verb	(Optional Adverb)
Thorns	*hurt*	*(badly).*
The fish	*are biting*	*(today).*

PATTERN II

Subject	Transitive Verb	Direct Object	(Optional Objective Complement)
The farmer	*planted*	*beans.*	
The teacher	*appointed*	*him*	*(chairman).*

PATTERN III

Subject	Transitive Verb	Indirect Object	Direct Object
Singing	*gives*	*me*	*pleasure.*
John	*made*	*himself*	*a guitar.*

PATTERN IV

Subject	Linking Verb	Predicate Noun
Mrs. Haley	*is*	*my teacher.*
He	*turned*	*traitor.*

PATTERN V

Subject	Linking Verb	Predicate Adjective
Prices	*are*	*high.*
His voice	*sounded*	*thin.*

Basic sentence patterns can be added to, reduced, combined, and rearranged in many ways. The construction of sentences affects the clarity, emphasis, and pace of speaking and writing. A speaker varies his sentences naturally, but a writer must do so consciously. Changing the parts of a sentence to vary a basic pattern is called *transformation.* Below are some common transformations.

1. Some patterns may be changed from the active voice to the passive voice.

Kernel: *The city sponsored the parade.*

Passive: *The parade was sponsored by the city.*

2. All patterns may be transformed into emphatic and negative statements.

Kernel: *She lives nearby.*

Emphatic: *She does live nearby.*

Negative: *She does not live nearby.*

3. All patterns may be transformed into several varieties of questions.

Kernels: *They picked berries.*
They were picking berries.

Yes-and-no question: *Did they pick berries?*

Information question: *When did they pick berries?*

Intonation question: *They picked berries?*

4. Many patterns may be changed into imperative statements.

Kernel: *You compared the two boats.*

Imperative: *Compare the two boats.*

5. Many patterns may be transformed into exclamatory statements.

Kernel: *We were happy.*

Exclamatory: *How happy we were!*

6. All patterns may be changed into subordinate structures of different kinds.

Kernels: *Paul was a good captain.*
Paul sailed to Easter Island.

Subordination: *Paul, who was a good captain, sailed to Easter Island.*
Paul, a good captain, sailed to Easter Island.
As Paul was a good captain, he sailed to Easter Island.
Being a good captain, Paul sailed to Easter Island.

7. Most patterns may be transformed into statements introduced by *there* or *it.*

Kernels: *Seven versions of that song are known.*
The song is well known.

There transformation: *There are seven known versions of that song.*

It transformation: *It is true that the song is well known.*

8. Many patterns may be compressed into modifiers.

Kernel: *The cherries tasted sweet.*

Modification: *The sweet-tasting cherries . . .*

9. Many patterns may be combined to form compound structures.

Kernels: *My glasses fell.*
My glasses broke.

Combination: *My glasses fell and broke.*

10. The parts of many patterns may be transposed to other positions in the sentence.

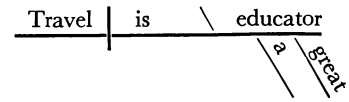
Kernel: *He kept down the price.*

Transposition: *He kept the price down.*

Sentence Fragments are common, especially in speech. They appear after many questions. For example, the question *Where were you?* could be answered by the phrase *At the beach.* The answer is a fragment that stands for (*I was*) *at the beach.*

Diagramming is a form of sentence analysis that shows how each part of a sentence is related to another. The diagram below divides the subject from the verb, the verb from its complement, and the complement from its modifiers.

Travel is a great educator.



Diagramming serves primarily as a teaching device. The forms of diagramming vary from the traditional model above to the more complex diagrams used by modern linguists. WILLIAM F. IRMSCHER

See also GRAMMAR; PARSING; SYNTAX.

SENTENCE, in law, is the period of prison confinement set by a court after an accused person has been found guilty of a crime for which the law provides punishment. For many years, judges pronounced sentence on convicted criminals according to their own judgment. But now, most laws provide a maximum and a minimum sentence which may be imposed for each particular crime. For instance, a state law may provide that the prison sentence for burglary shall be not less than 6 months and not more than 20 years.

Many criminologists believe that all prison sentences should be *indeterminate* (indefinite). That is, the court merely imposes the minimum and maximum limits of the penalty, and an administrative board determines the prisoner's time of release. FRED E. INBAU

SEOUL, *sohl* (pop. 5,536,377), is the capital of South Korea. It serves as the center of the nation's political, economic, and cultural activities. Seoul lies on the Han River, about 20 miles (32 kilometers) from Inch'ŏn, the city's seaport. For location, see KOREA (map).

Seoul combines features of old and modern Korea. High-rise apartment buildings tower above small houses with clay walls and thatched roofs. Buses on the Sam-Il Freeway contrast with hand-drawn carts on narrow dirt roads. Modern stores and banks compete with traditional bazaars.

More than half of South Korea's universities are in Seoul, including Seoul National University, the largest. Seoul's major industries process agricultural products and manufacture textiles. WILLIAM E. HENTHORN

See also KOREA (picture); KOREAN WAR.

SEPAL. See FLOWER (The Calyx; color pictures).

SEPARATE SCHOOL. See CANADA (Education); EDUCATION (Development of Canadian Education).

SEPARATION, LEGAL. See DIVORCE; ALIMONY.

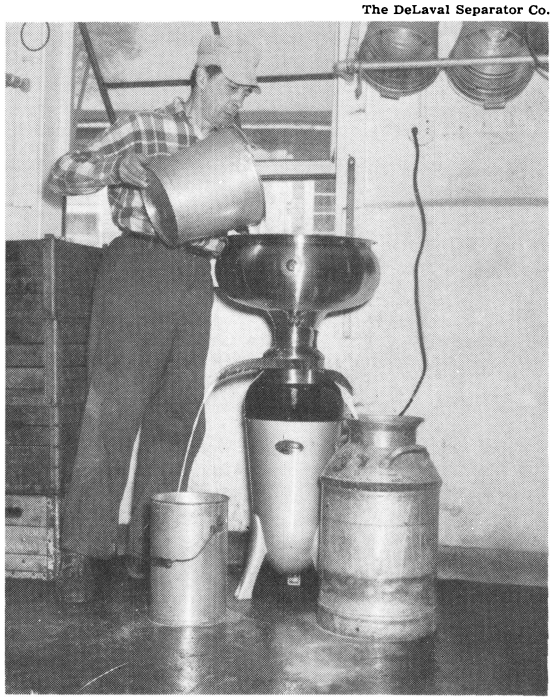
SEPARATION OF POWERS. See UNITED STATES, GOVERNMENT OF THE (Principles); GOVERNMENT (The Organization of Government).

SEPARATISTS. See PILGRIM; PURITAN.

SEPARATOR is a device that separates cream from milk. The first cream separators were crude wooden spoons that farmers used to skim cream off the top of milk. The farmers would let whole milk stand for several hours until cream, which is lighter than the rest of the milk, rose to the top. Then they would skim off the cream. This skimming method was wasteful because it left from 30 to 40 per cent of the valuable cream in the milk.

Carl Gustaf de Laval of Sweden invented a mechanical separator in 1877. It took all except a trace of cream from the milk. Present-day separators work on the same principle as De Laval's. They consist mainly of a large storage tank, a rotating bowl with cream and milk outlets, and a crank or electric motor to turn the bowl. Whole milk is poured into the supply tank and drains in small quantities into the bowl below. The bowl begins to turn rapidly. The centrifugal force that the revolving bowl sets up forces the light cream toward the center of the bowl. The heavier ingredients of milk are thrown toward the outer shell of the bowl. The cream at the center of the bowl drains off into one container, and the milk drains off into another. Various types of separators can handle from 25,000 to 110,000 pounds (11,300 to 49,900 kilograms) of milk per hour. EDWARD T. LEAVITT

A Cream Separator takes cream from whole milk. The cream flows into a small pail, *left.* Milk drains off into the large can. The DeLaval Separator Co.



See also BUTTER; CENTRIFUGE.

SEPHARDIM. See JEWS (Jews in America).

SEPIA, *SEE pih uh,* is a dark brown pigment made from an inky fluid found in certain cuttlefish. The fluid is dried, prepared as a powder, and then treated with caustic alkali and acids. Sepia is used to a limited extent to make water colors and drawing ink. The term *sepia* also applies to pigments of similar color made from other materials.

See also CUTTLEFISH.

SEPIOLITE. See MEERSCHAUM.

SEPOY REBELLION. In May, 1857, the *Sepoys* (Indian soldiers) in the Bengal Army revolted against their British officers. (*Sepoy* comes from the Hindi word *sipāhī,* meaning *soldier.*) Before the mutiny was finally put down in 1859, it had spread over a large part of northern India and resulted in the end of the British East India Company.

The rebellion was not a mere army revolt or a nationalistic uprising. Before 1857, several Indian mutinies had reflected discontent and distrust among the people. They saw threats to their institutions and beliefs in the gradual reduction of the old Indian aristocracy, new ideas of education, and economic discrimination. An immediate cause of the rebellion was a British order that Sepoys use greased cartridges. Some were greased with cow or hog fat. To use them, the Sepoys had to bite the end patches from them, and, in doing so, taste the fat. This was prohibited by the Hindu and Moslem religions.

The rebellion broke out at Meerut, near Delhi, on May 10. The mutineers restored the aged Mogul emperor of India to his throne. Conflicts between the rebels soon reduced their chances of success. At first, they seized several cities, including Delhi and Kanpur. But the British soon recaptured Delhi and saved Lucknow. By June, 1858, the British had suppressed the revolt, except for scattered pockets of resistance that continued into 1859.

The rebellion had far-reaching consequences. It led to the transfer of power in India from the British East India Company to the British government. More important, the shock of the mutiny drove a deeper wedge between the British and the Indians and led to increased segregation. This situation stimulated widespread nationalism. BRIJEN K. GUPTA

See also EAST INDIA COMPANY; INDIA (History); KANPUR; LUCKNOW.

SEPTEMBER

SEPTEMBER is the ninth month of the year. It was the seventh month in the old Roman calendar, and its name comes from the Latin *septem*, meaning *seven*. It became the ninth month when Julius Caesar changed the calendar to make the year begin on January 1, instead of March 1. September has always had thirty days.

Activities. Summer ends and autumn begins at the autumnal equinox, sometime between September 21 and 23 in the northern half of the world. September is one of the warmest months in the southern United States. States farther north have hot days during September, but nights are likely to be cool, and there are touches of golden haze. September is harvesttime for many crops. It was called the harvest month in Switzerland. The Anglo-Saxons called it the barley month.

Special Days. Labor Day, the only legal public holiday in September, comes on the first Monday of the month in Canada and the United States. After Labor Day, most children return to school.

Many peoples have celebrated harvest festivals in September. In Europe, the people hold feasts and games. In America, the Harvest Home supper celebrated the end of harvest. Fairs and exhibitions are often held in September. The Greeks honored Demeter during this month, and the Romans honored Ceres.

Five Jewish holidays are celebrated in September or early October. They are Rosh Hashanah, or New Year; Tzom Gedaliah, a fast day; Yom Kippur, the Day of Atonement; Sukkot, the Feast of Tabernacles; and Simhat Torah, a day of rejoicing.

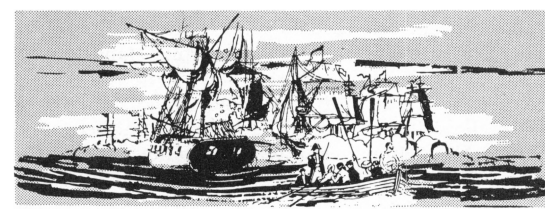
Hindus begin the 10-day celebration of Durga Puja, or the Festival of the Divine Mother, in September.

IMPORTANT SEPTEMBER EVENTS

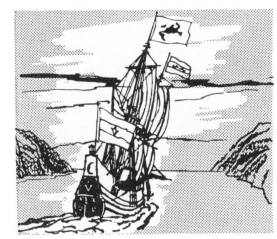
1 Engelbert Humperdinck, German composer, born 1854.
—Canadian provinces of Alberta and Saskatchewan established, 1905.
—German troops invaded Poland, starting World War II in Europe, 1939.
2 Great fire of London began, 1666.

—U.S. Department of the Treasury established, 1789.
—Queen Liliuokalani of Hawaii born 1838.
—Henry George, American economist, born 1839.
—Japan formally surrendered on V-J Day, 1945.
3 Great Britain signed Treasty of Paris, ending the Revolutionary War in America, 1783.
—Sarah Orne Jewett, American author, born 1849.
—Louis H. Sullivan, American architect, born 1856.
—First Labor Day celebrated as a legal public holiday, 1894.
4 François René de Chateaubriand, French author, born 1768.
—Marcus Whitman, American missionary, born 1802.
—Anton Bruckner, Austrian composer, born 1824.
—Phoebe Cary, American poet, born 1824.
—Daniel H. Burnham, American architect, born 1846.
—Transcontinental television service began with a telecast of the Japanese peace conference, 1951.
5 First Continental Congress assembled in Philadelphia, 1774.
—Jesse James, American desperado, born 1847.
6 Massachusetts Bay Colony established, 1628.
—Marquis de Lafayette, French statesman, born 1757.
—John Dalton, English scientist, born 1766.
—Jane Addams, founder of Hull House, born 1860.
—President McKinley shot by an assassin, 1901.
7 Queen Elizabeth I of England born 1533.
—Brazil proclaimed its independence, 1822.
—American financier J. P. Morgan, Jr., born 1867.
—Blitz of London began, 1940.
8 First permanent white settlement in what is now America founded in St. Augustine, Fla., 1565.
—Antonín Dvořák, Czech composer, born 1841.

8 Robert A. Taft, Senator from Ohio, born 1889.
—Italy announced its surrender in World War II, 1943.
9 Cardinal Richelieu, French statesman, born 1585.
—Luigi Galvani, Italian anatomist, born 1737.
—California became the 31st state, 1850.
10 Thomas Sydenham, English physician, born 1624.
—Perry won the Battle of Lake Erie, 1813.



—Elias Howe patented his sewing machine, 1846.
—Arthur H. Compton, American physicist, born 1892.
11 Battle of Brandywine, 1777.
—William Sydney Porter, American short-story writer who used the pseudonym O. Henry, born 1862.
—English scientist Sir James H. Jeans born 1877.
12 Henry Hudson entered the river named for him, 1609.



—Inventor Richard J. Gatling born 1818.
—H. L. Mencken, American editor, born 1880.
—Russians launched first rocket to the moon, 1959.
13 Walter Reed, American surgeon, born 1851.
—John J. Pershing, American general, born 1860.
—Composer Arnold Schönberg born 1874.
14 Great Britain and its American colonies adopted the Gregorian calendar, 1752.
—Alexander von Humboldt, German scientist and geographer, born 1769.
—Retreating Russians burned Moscow, 1812.
—Francis Scott Key wrote "The Star-Spangled Banner" during the attack on Fort McHenry, 1814.
—American illustrator Charles Dana Gibson born 1867.
15 Novelist James Fenimore Cooper born 1789.
—Porfirio Díaz, former president of Mexico, born 1830.
—William Howard Taft, 27th President of the United States, born in Cincinnati, Ohio, 1857.
—Orchestra conductor Bruno Walter born 1876.
—British army became the first to use military tanks, 1916.

Citizenship Day and Constitution Day are observed on September 17. Constitutional Convention delegates signed the Constitution on that day in 1787.

September Symbols. The morning-glory is the flower for September. Sapphire is the gem. GRACE HUMPHREY

Quotations

By all these lovely tokens
September days are here,
With summer's best of weather
And autumn's best of cheer.
Helen Hunt Jackson

The morrow was a bright September morn;
The earth was beautiful as if newborn;
There was nameless splendor everywhere,
That wild exhilaration in the air,
Which makes the passers in the city street
Congratulate each other as they meet.
Henry Wadsworth Longfellow

Just after the death of the flowers,
And before they are buried in snow,
There comes a festival season
When Nature is all aglow.
Author Unknown

Heap high the farmer's wintry hoard!
Heap high the golden corn!
John Greenleaf Whittier

Related Articles in WORLD BOOK include:

Autumn	Labor Day	Sukkot
Calendar	Morning-Glory	Summer
Constitution Day	Rosh Hashanah	Yom Kippur
Harvest Moon	Sapphire	

IMPORTANT SEPTEMBER EVENTS

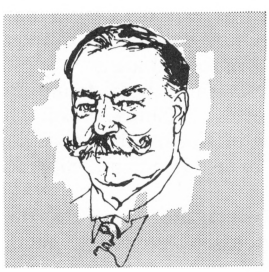
16 Pilgrims sailed from England in the *Mayflower*, 1620.

—Francis Parkman, American historian, born 1823.
—James J. Hill, American railroad builder, born 1838.
—Selective Service Act passed, 1940.

17 Constitution of the United States signed, 1787.
—Friedrich Wilhelm von Steuben, German soldier in the Revolutionary War in America, born 1730.
—Constitution Day and Citizenship Day in the U.S.

18 Samuel Johnson, English author and dictionary maker, born 1709.
—Quebec surrendered to the English, 1759.
—Washington laid cornerstone of the Capitol, 1793.
—Chile declared its independence from Spain, 1810.
—Jean Foucault, French physicist, born 1819.
—John George Diefenbaker, prime minister of Canada, born 1895.
—Japanese forces invaded Manchuria, 1931.

19 Edward, the Black Prince, won the Battle of Poitiers, 1356.
—Battle of Saratoga began, 1777.
—Washington's Farewell Address published, 1796.
—Lajos Kossuth, Hungarian patriot, born 1802.
—Battle of Chickamauga in Civil War began, 1863.
—President James A. Garfield died of assassin's shot, 1881.

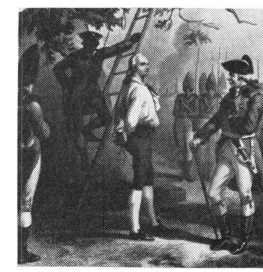


20 Sister Elizabeth Kenny, Australian nurse who developed a method of treating poliomyelitis, born 1886.

21 Girolamo Savonarola, Italian reformer, born 1452.
—England abandoned gold standard, 1931.
—Great hurricane swept the Atlantic Coast, 1938.

22 Earl of Chesterfield, English statesman and author, born 1694.

22 Nathan Hale put to death as a spy by British, 1776.
—Michael Faraday, English scientist, born 1791.
—Lincoln issued preliminary emancipation proclamation, 1862.



23 Augustus, first Roman emperor, born 63 B.C.
—Thomas Osborne, American prison reformer, born 1859.
—John Paul Jones, commanding the *Bonhomme Richard*, defeated the British ship *Serapis*, 1779.
—William McGuffey, publisher of McGuffey readers, born 1800.
—American writer Walter Lippmann born 1889.

24 Horace Walpole, English author, born 1717.
—John Marshall, great Chief Justice of the United States, born 1755.

25 Columbus sailed on second voyage to America, 1493.
—Balboa discovered the Pacific Ocean, 1513.
—*Publick Occurrences*, first American newspaper, appeared in Boston, 1690.
—Amendment 12 to the United States Constitution, changing details of presidential elections, proclaimed, 1804.
—William Faulkner, American novelist, born 1897.
—Dimitri Shostakovich, Russian composer, born 1906.

26 George Gershwin, American composer, born 1898.

27 Samuel Adams, American patriot, born 1722.
—George Cruikshank, English caricaturist, born 1792.
—Alfred T. Mahan, American naval officer and historian, born 1840.
—Thomas Nast, American cartoonist, born 1840.
—The *Queen Elizabeth* launched at Glasgow, 1938.
—Germany, Italy, and Japan signed a mutual military aid pact, 1940.

28 William the Conqueror landed in England, 1066.
—Frances E. Willard, American temperance leader, born 1839.
—Georges Clemenceau, French premier during World War I, born 1841.
—Kate Douglas Wiggin, American author, born 1856.
—Elmer Rice, American playwright, born 1892.

29 Robert Clive, British soldier and founder of British rule in India, born 1725.
—Horatio Nelson, British naval hero, born 1758.
—Henry H. Richardson, American architect, born 1838.
—Miguel de Unamuno, Spanish philosopher, born 1864.
—Nuclear physicist Enrico Fermi born 1901.

30 Pompey, Roman general, born 106 B.C.

SEPTIC SORE THROAT. See STREP THROAT.

SEPTIC TANK. See SEWAGE (Rural Sewage Systems).

SEPTILLION, *sep TILL yun*, in the United States and France, is a number followed by 24 zeros. One septillion is written 1,000,000,000,000,000,000,000,000. In Britain and Germany, it is a number followed by 42 zeros. See also DECIMAL NUMERAL SYSTEM (Larger Numbers).

SEPTUAGINT, *SEHP tyoo uh jint*, is the oldest Greek translation of the Old Testament. The name *septuagint* comes from a Latin word meaning *seventy*. A legend says that King Ptolemy II of Egypt had 70 Jewish scholars translate the *Torah*, or Law, the first five books of the Old Testament. Most scholars believe the translation was prepared for Greek-speaking Jews who no longer understood Hebrew, and was not completed at one time. The Law was translated about 250 B.C. The other books were completed during the next 200 years. The most famous manuscripts of the Septuagint are the *Vaticanus*, in the Vatican Library in Rome, and the *Alexandrinus* and *Sinaiticus*, in London. ROBERT GORDIS

SEPTUM. See HEART (Parts of the Heart); NOSE.

SEQUOIA, *see KWOY uh*, is a tree that ranks among the largest and oldest living things on earth. Millions of years ago these trees grew in large forests throughout much of the world. There were many different kinds. But only two kinds of the true sequoias remain, along with a Chinese tree that is closely related to them. Both kinds of true sequoias, the redwood and the giant sequoia, are found chiefly in California. The name *sequoia* comes from that of a Cherokee Indian who invented a written alphabet for his tribe.

The Redwood

Redwoods, also called *coast* and *California redwoods*, grow in the mountains on the Pacific Coast from central California into southern Oregon. The trees thrive there in the relatively warm, moist climate.

Redwoods are the tallest living trees. They grow over 300 feet (91 meters) high, or about as high as a 30-story building. Their lowest branches may be more than 150 feet (46 meters) from the ground. Many redwood trunks are over 10 feet (3 meters) in diameter.

The redwood's bark is from 6 to 12 inches (15 to 30 centimeters) thick and is deeply furrowed. It ranges in color from red-brown to cinnamon-brown. The wood of the tree is a light clear red. When it is exposed to the weather, it turns dark red. It is durable, and is important in the lumbering industry. A single tree may give as much as 480,000 board feet (1,130 cubic meters) of lumber. See REDWOOD.

The Giant Sequoia

The giant sequoia is sometimes called the *big tree* or *Sierra redwood*. It grows only on the western slopes of the Sierra Nevada mountains of California at elevations from 5,000 to 7,800 feet (1,500 to 2,380 meters).

The giant sequoias were once distributed over most of the Northern Hemisphere. They now grow in only about 70 groves.

Size. Giant sequoias do not grow as tall as redwoods. But their trunks are much larger. Several of them are about 100 feet (30 meters) around at the base. The diameter of the widest trunk is 37.3 feet (11.4 meters). The world's largest tree in volume of wood is the General Sherman Tree, in Sequoia National Park (see SEQUOIA NATIONAL PARK). It is 272.4 feet (83.03 meters) high, and the base of its trunk has a circumference of 101.6 feet (30.97 meters). It has been estimated that this tree would yield over 600,000 board feet (1,400 cubic meters) of lumber. Another of the largest giant sequoias is the Grizzly Giant in the Mariposa Grove in Yosemite National Park.

The wood of giant sequoias is very brittle and therefore of little use in lumbering. Also, because of the great size of the trees, it is not practical to log them.

Age. Scientists can tell much about a tree's history and age by looking at the *growth rings*. Each year the tree forms a new layer of wood just inside the bark. The number of rings that make up the trunk show how old the tree is. Sometimes the climate during the year is also shown by the growth ring. Wide rings show that the growing season was good, while narrow rings show that the season was poor. Sometimes lack of rain or moisture will cause a poor growing season. See TREE (illustration: How a Tree Reveals Its History).

Many of the giant sequoias are several thousand years old. It has been estimated that the General Sherman Tree is as much as 3,500 years old. Before a law was passed that protected sequoias from being cut, one of the oldest and largest was chopped down. By counting its rings, it was found that the tree dated back to 1305 B.C. Therefore, it was more than a thousand years old at the time of the birth of Christ.

Habits. The giant sequoia is an evergreen. Its scale-like needles are $\frac{1}{4}$ to $\frac{1}{2}$ inch (6 to 13 millimeters) long. They lie more or less parallel to the twig, except for the tip, which is sharp and stands out. The cone is woody and oval-shaped. It grows about 2 to 3 inches (5 to 8 centimeters) long. Each cone contains numerous small seeds, which take two years to mature. The seeds are only $\frac{1}{4}$ inch (6 millimeters) long. It would take about 50,000 of them to weigh 1 pound (0.5 kilogram).

The giant sequoias are very durable. None of these trees has been known to die from old age, disease, or insect attack. However, lightning has destroyed the tops of most of the largest sequoia trees.

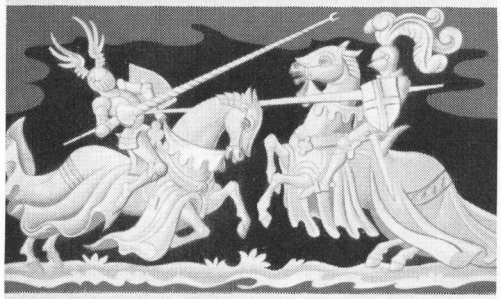
The Dawn Redwood

The dawn redwood is the only known close relative of the sequoias. Scientists once believed that it had become extinct millions of years ago. They studied it and knew about it only from fossil remains (see FOSSIL). But in 1944, a Chinese botanist, Tsang Wang, discovered the dawn redwood growing in a hidden valley of central China. He compared cones and leaves of the tree with fossil specimens in a museum in Peking and found them to be identical. Thus it was discovered that a tree, believed to have become extinct 20 million years before, was still growing in several areas.

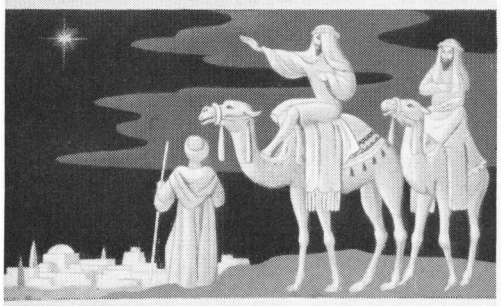
Living dawn redwoods have since been found in Szechwan and Hupeh provinces of China. Fossil remains show that it once grew in North America as far south as California, as well as in Greenland, Siberia, and Japan.

Unlike the true sequoias, which are evergreens, the dawn redwood is a *deciduous* tree (see DECIDUOUS TREE). Each fall it sheds its leaves and new ones appear again

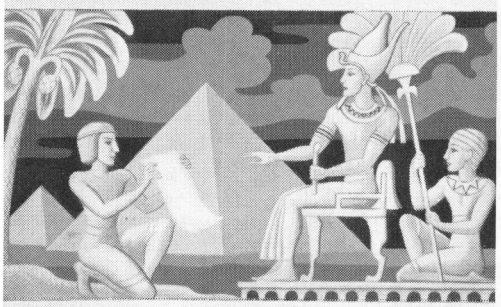
The Present Time



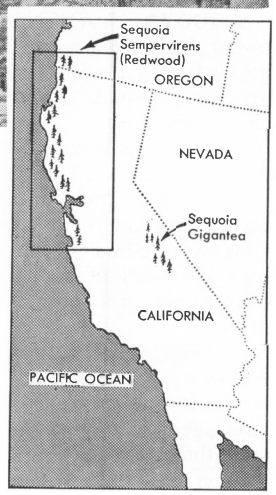
1100 A.D.



At The Time Of The Birth Of Christ



2000 B.C.



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in the spring. Also, unlike other sequoias, the dawn redwood bears its cones on long naked stalks rather than on needle-bearing twigs or branches.

Like the other sequoias, dawn redwoods grow readily from seeds. Scientists brought seedling trees from China and planted them throughout the Pacific Northwest and in southeastern Alaska. Most of the seedlings survived, and have grown.

The General Sherman Tree, *above,* in Sequoia National Park, is one of the oldest and largest living things on earth. The huge tree compares in age with the ancient pyramids of Egypt. It may be as much as 3,500 years old. Sequoias grow only on the western coast, *right.*

Protection of Sequoias

Most of the large sequoias are under protection of the United States government. Only 8 per cent of the

trees that are more than 10 feet (3 meters) in diameter are privately owned. Strict provision is made against forest fires and great care is taken to avoid any injury.

Scientific Classification. Sequoias belong to the taxodium family, *Taxodiaceae*. The redwood is genus *Sequoia*, species *S. sempervirens*. The giant sequoia is classified as *Sequoiadendron giganteum*. The dawn redwood is *Metasequoia glyptostroboides*. RICHARD J. PRESTON, JR.

See also CONE-BEARING PLANT; REDWOOD; TREE (picture).

SEQUOIA NATIONAL PARK is the home of one of the finest existing stands of giant sequoia trees. In this park are thousands of these big trees, several hundred of which are more than 10 feet (3 meters) in diameter. The world's largest tree in volume of wood is a sequoia known as the General Sherman Tree. It is 272.4 feet (83.03 meters) high and has a circumference of 101.6 feet (30.97 meters). The diameter of its trunk at the base, 36.5 feet (11.13 meters), is wider than most streets. The tree is about 3,500 years old. See SEQUOIA.

The park is on the western slopes of the Sierra Nevada in central California. It covers 386,862.97 acres (156,557.87 hectares), most of it mountain wilderness. There is a difference in altitude of over 2 miles (3.2 kilometers) from the lowest point in the park to the highest. From the top of Mount Whitney (14,495 feet, or 4,418 meters), one of the highest peaks in the United States, the visitor can look 100 miles (160 kilometers) east to mountains around Death Valley.

There are over 900 miles (1,400 kilometers) of trails in the park. Mountain streams and lakes offer fine trout fishing. Kern River Canyon, Crystal Cave, and the rugged crags of the Sierras attract thousands of visitors. The park is popular for winter sports.

Sequoia National Park was established on September 25, 1890, and was the second national park created. Yellowstone National Park, the oldest, was set aside 18 years earlier. It was largely through the efforts of George W. Stewart that the giant sequoia trees were saved from the lumber mills.

Kings Canyon National Park adjoins Sequoia National Park on the north. The National Park Service administers both as one park. JAMES J. CULLINANE

See also KINGS CANYON NATIONAL PARK.

SEQUOYA, *sih KWOY uh* (1760?-1843), a Cherokee Indian, invented a system of writing. He has been called the *Cadmus of America* (see CADMUS). The giant sequoia trees and Sequoia National Park in California are named after him.

Sequoya was born in eastern Tennessee. His family was highly respected among the Cherokee for its knowledge of tribal traditions and religion. As an adult, Sequoya met many white people and became fascinated with their method of communicating by writing. He set himself the task of inventing a system of writing for his own people, and completed it in 1821 after 12 years of work.

Sequoya's chief aim was to record ancient tribal culture in a permanent form. The Cherokee also used his system to publish books and newspapers in their own language, and thousands of them learned to read and write the language.

Later, Sequoya became interested in the general advancement of Indians. He went to Washington, D.C., in 1828 as a representative of the Western tribes. Sequoya helped settle bitter differences that arose among the Cherokee after the U.S. government forced them to move to Indian Territory (now Oklahoma) in the 1830's. He died in Mexico while searching for some lost Cherokee.

Culver

Sequoya Invented a System of Writing suitable to the Cherokee language. He later became an Indian historian.

A statue of Sequoya represents Oklahoma in Statuary Hall in the U.S. Capitol. Sequoya's home, near Sallisaw, Okla., stands as a memorial to him. ROBERT K. THOMAS

SERAGLIO, *see RAL yoh*, or *seh RAHL yoh*, is the name of the ancient home of the Turkish sultan at Istanbul (formerly Constantinople). The name seraglio comes from the Italian translation of the Persian word *serai*, which means *palace*. The Seraglio stands on a finger of land which sticks out into the sea. The walls that surround the palace once enclosed many temples, the Museum of Constantinople, the harem, and many large public buildings.

The Turkish sultan did not occupy the palace after 1839. The Seraglio is now open to the public as a museum. It contains treasures from Hittite, ancient Greek, and early Roman and Turkish civilizations. See also SULTAN. SYDNEY N. FISHER

SERAJEVO. See SARAJEVO.

SERAPE. See MEXICO (Clothing).

SERAPHIM. See CHERUB; DECORATIONS AND MEDALS (Sweden; picture).

SERAPIS, a ship. See JONES, JOHN PAUL.

SERAPIS, *see RAY pis*, was the name of a god who was worshiped by the Greeks and Romans in Egypt. He was a god of healing, and the protector of sailors. His

name comes from the names of Osiris and Apis. Osiris was the most human and kind Egyptian god. He was killed by the god of evil, and became judge of the underworld. Serapis represented Osiris after he had passed into the underworld and had taken the form of Apis, a sacred bull. Many pilgrims came to worship a statue of Serapis in ancient Memphis. JAMES F. CRONIN

SERBIA, *SUR bih uh*, is the largest of the six republics of Yugoslavia. Serbia covers about 34,100 square miles (88,319 square kilometers) in eastern Yugoslavia. It includes the independent provinces of Kosovo and Vojvodina. Serbia has a population of about 8,468,000. Belgrade, the capital of Yugoslavia, is Serbia's largest city.

Land. A number of rivers flow through Serbia. They include the Danube, Yugoslavia's major waterway, which flows southeast to the Black Sea. The Morava River flows north through the hills of southern and central Serbia and then empties into the Danube. Mountains rise on Serbia's eastern and western borders. Serbia has deposits of antimony, coal, copper, lead, and zinc.

People. More than 70 per cent of Serbia's people are Serbs. Other groups include Albanians, Croats, Hungarians, and Slovenes. Most of the people belong to the Eastern Orthodox Church or are Moslems. Serbo-Croatian is the principal language. But the Serbs use the Cyrillic alphabet, and the Croats use the Roman alphabet. Serbs frequently eat grilled meat, thick soups, goat cheese, and spicy salads. They also like thick, sweet Turkish coffee and plum brandy.

Economy. Serbia's best farmland lies in the northern province of Vojvodina and in Šumadija, an area south of Belgrade. Farmers in Serbia grow cereal grains, fruits, sugar beets, sunflower seeds, and tobacco. They raise cattle, hogs, and sheep. Industrialization has developed rapidly in Serbia since the mid-1940's. Products made in Serbian factories include chemicals, electrical products, and textiles.

History. During the A.D. 600's, various groups of Slavs, including the ancestors of the Serbs, settled in the center of the Balkan Peninsula. Each tribe had its own leader until the late 1100's, when Stephen Nemanja, a warrior and chief, formed the first united Serbian state. During the 1300's, King Stephen Dušan led the country in successful wars against the Byzantine Empire. The Serbian kingdom began to break up after his death in 1355. The Ottoman Turks conquered Serbia in the battle of Kosovo in 1389.

WORLD BOOK map

Location of Serbia

The Ottoman Empire ruled Serbia for nearly 500 years, but the Serbs never lost their national pride. George Petrović, a Serbian peasant who was nicknamed Black George, led an uprising against the Turks in 1804. Another Serbian peasant leader, Miloš Obrenović, led a second revolt in 1815. The Serbs won some liberties in these struggles. Serbia regained independence in 1878, following Turkey's defeat by Russia. In the Balkan Wars (1912-1913), Serbia and other Balkan countries gained control of almost all of Turkey's possessions in Europe.

During the early 1900's, various economic and political conflicts developed between Serbia and Austria-Hungary. In 1914, Austrian Archduke Francis Ferdinand was assassinated in Serbia. World War I began a month later when Austria-Hungary declared war on Serbia. After the war ended in 1918, Serbia helped form the Kingdom of Serbs, Croats, and Slovenes. This kingdom became Yugoslavia in 1929. Following the end of World War II in 1945, Serbia became a republic of the federal state of Yugoslavia. During the 1960's and 1970's, regional pride led to quarrels between Serbia and other Yugoslav republics. ALVIN Z. RUBINSTEIN

See also YUGOSLAVIA; BALKANS; SLAV; WORLD WAR I (Causes of the War; The War Begins).

SERBO-CROATIAN LANGUAGE. See YUGOSLAVIA (The People).

SERBS, CROATS, AND SLOVENES, KINGDOM OF THE. See YUGOSLAVIA (After World War I).

SEREDY, *SHER uh dih*, **KATE** (1896-1975), wrote and illustrated *The White Stag* (1937), which won the Newbery medal in 1938. The book is based on the legendary account of the founding of Hungary, when Attila, guided by the white stag and the red eagle, led his people to their promised land. The magnificent drawings in the book are an integral part of the text.

Kate Seredy was born in Budapest, Hungary. She attended the Academy of Art in that city and studied art in Italy, France, and Germany. During World War I, she was a nurse in military hospitals. She came to the United States in 1922 and learned English in an amazingly short time. Twelve years after coming to America, she wrote and illustrated *The Good Master* (1935), a story based on her own childhood in Hungary. This was followed by a sequel, *The Singing Tree* (1939). Her other books include *A Tree for Peter* (1941), *The Chestry Oak* (1948), and *Gypsy* (1951). EVELYN RAY SICKELS

See also ATTILA (picture); DANCING (picture).

SERENADE, *SAIR uh NAYD*, is a type of music, or the act of presenting such music, outdoors at night. It is usually an act of gallantry that is performed under a lady's window. *Serenade* is also the name for a type of musical composition, such as Mozart's *Eine kleine Nachtmusik*.

SERF. The large class of peasants known as serfs developed in the early Middle Ages. The term *serf* comes from the Latin word *servus*, which means *slave*. The status of a serf was midway between that of a freeman and a slave. The serf was a bondman, generally bound to the soil, and required to provide certain payments and services to his lord. In these respects,

he was not free. But by custom, the serf enjoyed certain rights of which he could not be justly deprived.

A serf's holdings usually included a crude house, the adjoining plot of ground, a share of surrounding fields, and a few animals. Part of his crop went to the lord of the manor as rent payment. The serf also worked on the lord's land and made special payments to him.

The institution of serfdom is usually connected with medieval Europe, although it existed elsewhere under corresponding conditions. In the later Middle Ages, the rise of towns weakened the manorial system and caused the gradual decline of serfdom. Many serfs escaped to towns. Others rose in revolt against the lords. In some cases, landlords found it more profitable to give the serfs money for their labor. In the process, the serfs obtained their freedom. Other serfs began to sell their holdings and leave the estates. In time, their liberty was recognized by law. English law ended serfdom in the 1600's. Few serfs were left in France in 1789, when the French Revolution began. But Russia and Prussia had serfs until the 1800's. BRYCE LYON

See also FEUDALISM.

SERGE is a fabric made from wool, rayon, cotton, or silk. It has a twill weave, which appears as diagonal or slanting ribs or lines on the surface of the material. Clothiers use worsted serge to make dresses, suits, coats, and caps. Silk serge is used largely for linings. Serge comes in widths of 44, 50, 54, and 60 inches (112, 127, 137, and 152 centimeters).

SERGEANT. See RANK IN ARMED SERVICES.

SERGEANT AT ARMS is an officer who keeps order during the meetings of clubs and deliberative bodies. He also serves legal papers for the assembly. He has the power to compel members to attend sessions when their presence is necessary to make a quorum.

Each branch of the United States Congress has an office for a sergeant at arms. When the sergeant at arms carries the *mace* (staff) down the aisle of the legislature, all disorder must cease (see MACE). Any disorderly member is guilty of contempt.

Historians believe that the office of sergeant at arms was created by Richard I of England, when the king appointed a corps of 24 bodyguards to attend him and guard his person. GEORGE E. MOWRY

SERIAL POSITION EFFECT. See MEMORY (What Do We Remember?).

SERIES, in mathematics, is the sum of the terms of a sequence. For example, the set of numbers 2, 4, 6, 8, 10 form a *sequence*. If you add these numbers together, they form the *series* $2 + 4 + 6 + 8 + 10$. A sequence can be any set of *terms* (numbers or algebraic expressions) arranged in a specific order. An example of a sequence with algebraic terms is a, ar, ar^2, ar^3, ar^4. The related series is $a + ar + ar^2 + ar^3 + ar^4$. A series such as $\frac{1}{2} - \frac{1}{3} + \frac{1}{4} - \frac{1}{5} + \ldots$ contains both positive and negative terms.

Mathematicians name series in a variety of ways to describe how the terms are formed. They call the series $2 + 4 + 6 + 8 + 10$ an *arithmetic series*. Each term of an arithmetic series is formed by adding a certain quantity to the preceding term. In this example, the quantity added is 2. (The sequence 2, 4, 6, 8, 10 is called an *arithmetic progression.*) The series $a + ar + ar^2 + ar^3 + ar^4$ is an example of a *geometric series*. Each term of such a series is formed by multiplying the preceding term by a certain quantity called the *common ratio*. In this example, the common ratio is r. (The sequence a, ar, ar^2, ar^3, ar^4 is called a *geometric progression.*)

Other common types include power series, trigonometric series, and factorial series. The terms of a *power series* contain some quantity raised to successively higher powers. The simplest power series is $1 + x + x^2 + x^3 + x^4 + x^5$ and so on. The terms of a *trigonometric series* contain such expressions as sines and cosines of angles. A simple *factorial series* has the form $1 + (1 \times 2) + (1 \times 2 \times 3)$ and so on. When written in *factorial notation*, this series appears as follows: $1! + 2! + 3!$.

Series that become important mathematical tools are often named for the men who develop them. Notable among these are *Fourier's Series*, *Taylor's Series*, and *Maclaurin's Series*.

All series are either *finite* or *infinite*, depending on the number of terms they have. A finite series has a definite number of terms that you can count. For example, the series $2 + 4 + 6 + 8 + 10$ is a finite series because it has only 5 terms. An infinite series goes on indefinitely so that you cannot count the number of terms. For example, the sum of all the numbers used in counting by 2's is an infinite series. It is written:

$$2 + 4 + 6 + 8 + 10 + \ldots$$

The dots at the end of the series indicate that there is no "last" term. Instead, an infinite number of terms follow the ones that are written.

Working with Finite Series

The most common questions asked about a finite series are: (1) What is the value of a certain term? (2) What is the sum of a certain number of terms? For example, suppose you want to find the 7th term in the sequence of odd numbers (1, 3, 5, 7, 9, and so on). You can find the answer by merely writing out the sequence:

$$1, 3, 5, 7, 9, 11, 13$$

The example shows that the 7th term is 13. In a similar way, you can find the sum of the first 7 terms in the related series:

$$1 + 3 + 5 + 7 + 9 + 11 + 13 = 49$$

Adding the terms shows that the sum is 49.

You can also use mathematical formulas to find terms and sums of many series. The formulas are especially helpful when you must work with a large number of terms. In the formulas, the letter n usually represents the number of a term. For example, the formula for the nth term (U_n) in the sequence of odd numbers is

$$U_n = 2n - 1$$

Using this formula, you can calculate the 7th term in the sequence as follows:

$$U_7 = (2 \times 7) - 1 = 14 - 1 = 13$$

This is the same answer you obtain when you write out the sequence. The formula for the sum of the first n terms (S_n) of the odd-number series is

$$S_n = n^2$$

The sum of the first 7 terms is therefore

$$S_7 = 7^2 = 49$$

Again, your answer agrees with the sum you obtain by adding the terms.

Mathematicians have developed similar formulas for finding terms and sums of many kinds of series. For more information about finding terms and sums of progressions, see the article on PROGRESSIONS.

Working with Infinite Series

Probably the simplest infinite series is a geometric series whose common ratio is less than 1. For example, the following geometric series has a common ratio of $\frac{1}{2}$:

$$1 + \tfrac{1}{2} + \tfrac{1}{4} + \tfrac{1}{8} + \tfrac{1}{16} + \ldots$$

How do you find the sum of this series if it has an infinite number of terms? You can start by making a table showing the sum of the first two terms, the first three, the first four, and so on.

Number of Terms (n)	Last Term	Sum of n Terms
1	1	1
2	$\frac{1}{2}$	$1\frac{1}{2}$
3	$\frac{1}{4}$	$1\frac{3}{4}$
4	$\frac{1}{8}$	$1\frac{7}{8}$
10	$\frac{1}{512}$	$1\frac{511}{512}$

The table shows that the sum gets closer to 2 as you add more terms. If you add enough terms, you can make the sum come as close to 2 as you wish. But the sum never reaches 2. The number 2, then, is called the *limit of the sum of n terms as n increases without bound.* You can express this statement with mathematical symbols as follows:

$$\lim_{n \to \infty} S_n = 2$$

The symbols $n \to \infty$ signify that the number of terms increases without bound. Such a limit may also be called merely the "sum" of the series.

You can use mathematical formulas to prove that the sum of this series is 2. The formula for the sum of n terms (S_n) of any geometric progression is:

$$S_n = \frac{a - ar^n}{1 - r}$$

In this formula, a represents the first term of the series, r the common ratio, and n the number of terms. The expression above can also be written as two terms:

$$S_n = \frac{a}{1 - r} - \frac{ar^n}{1 - r}$$

Consider the second term in the above formula. Let the common ratio, r, be any number less than 1. Then, as the number of terms, n, increases without bound, the factor r^n approaches zero. The limit of the second term is therefore zero. (You may want to tabulate some values for the second term to see why this is so. Make r any value less than 1. Then calculate the value of the second term for several increasing values of n.)

The second term of the formula is zero only when n increases without bound. Therefore, we must write:

$$\lim_{n \to \infty} S_n = \frac{a}{1 - r}$$

To put this formula to work, we merely insert the proper values. In our example, $a = 1$, and $r = \frac{1}{2}$:

$$\lim_{n \to \infty} S_n = \frac{1}{1 - \frac{1}{2}} = \frac{1}{\frac{1}{2}} = 2$$

The formula shows that the limit of the sum is 2, the same number arrived at when the series was tabulated.

When the sum of a series approaches a limit as the number of terms increases without bound, the series is said to *converge*. Otherwise, the series is said to *diverge*. Mathematicians can prove that many series converge. However, even though convergence can be proved, it is often difficult or impossible to develop a formula for the sum. In such cases, the sum must be obtained approximately by adding terms in the series. In this way, mathematicians calculate many important quantities. These quantities include the trigonometric functions; logarithms; and mathematical constants such as π and e (the base of the natural logarithms).

One of the early expressions for π was developed by the Scotch mathematician James Gregory (1638-1675):

$$\pi = 4(1 - \tfrac{1}{3} + \tfrac{1}{5} - \tfrac{1}{7} + \tfrac{1}{9} - \tfrac{1}{11} + \ldots)$$

The terms of this series form a *harmonic progression.* Gregory's series converges slowly. This means that you have to add a large number of terms in order to extend the accuracy only a little bit. Today, mathematicians use other series that converge more rapidly to the value of π. The expression below shows π carried out to 20 decimal places:

$$\pi = 3.14159265358979323846\ldots$$

With rapidly converging series and the aid of high speed computers, mathematicians can obtain a value of π correct to more than 100,000 decimal places.

For the series used to calculate e, see LOGARITHMS (Natural Logarithms).

Working with Odd Numbers

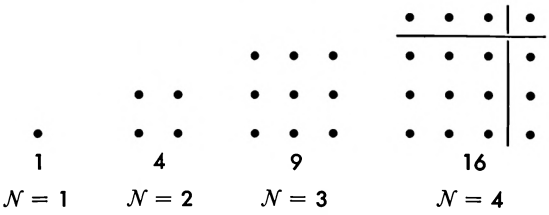
Consider the formula for the sum of the series of odd numbers ($1 + 3 + 5 + 7 + \ldots$):

$$S_n = n^2$$

This formula points out a remarkable fact: *the sum of n successive odd numbers is always a perfect square.* The table below illustrates this fact.

Number of Terms	Last Term of Series	Sum of n Terms
n	$2n - 1$	n^2
1	1	1
2	3	4
3	5	9
4	7	16
5	9	25
6	11	36
7	13	49
8	15	64
9	17	81
10	19	100

The arrows in the table show the relation between the perfect squares and the successive odd numbers. The followers of the Greek mathematician Pythagoras knew this relationship as early as 540 B.C. They discovered it while studying figurate numbers. *Figurate numbers* are arrangements of dots in the form of squares, triangles, and other geometrical figures. For example, the Pythagoreans represented the first 4 perfect squares as follows:



They saw that to form each new perfect square they had to add an odd number of dots to the preceding square. The number of added dots increased by 2 each time. Thus the added dots formed a sequence of odd numbers. To the number 1, the Pythagoreans added *3* dots to make 4, then they added *5* more dots to make 9, and so on. The last diagram shows how the Pythagoreans formed 16 by adding dots to 9. They added (1) 3 dots in a row along the top; (2) 3 more in a column on the right side; and (3) a single dot in the upper right corner. The total number of dots added was $(2 \times 3) + 1 = 7$, an odd number.

In general, N can be used to represent the number of dots in a row or column of any square number. Then, to form the next square, one has to add (1) N dots in a row along the top; (2) N more in a column on the right side; and (3) a single dot in the upper right corner. The total number of dots added would be $(2N + 1)$ which is always an odd number. With each new square, N increases by 1. As a result, the number of added dots $(2N + 1)$ increases by 2. Thus the number of added dots forms a sequence of odd numbers. Also, each perfect square is the sum of a certain number of terms in the odd-number series. PHILLIP S. JONES

SERIES MOTOR. See ELECTRIC MOTOR (Kinds).

SERIF. See ALPHABET (Capital Letters); LETTERING (illustration: Parts of Letters).

SERIGRAPHY. See SILK-SCREEN PRINTING.

SERKIN, *SEHR kin*, RUDOLF (1903-), is a noted pianist. Born in Eger, Austria (now Cheb, Czechoslovakia), he made his debut at the age of 12. Five years later, he began an active career as a concert pianist in Berlin. Serkin left Germany in 1933 and spent most of his time after 1935 in the United States. He joined the faculty of the Curtis Institute of Music in Philadelphia in 1939. ROBERT U. NELSON

SERLING, ROD (1924-1975), an American dramatist, was one of the first writers to reach playwright status solely through performances of his works on radio and television. He began his career writing radio scripts in 1948, and turned to television in 1950. Several of his prize-winning dramas, notably *Patterns* (1955), *The Rack* (1955), and *Requiem for a Heavyweight* (1956), have been included in anthologies and in textbooks. Serling was born in Syracuse, N.Y. PAUL MOLLOY

SERLIO, SEBASTIANO. See DRAMA (The Italian Stage; picture).

SERMON ON THE MOUNT. See JESUS CHRIST (Ministry).

SEROTONIN, *SEE roh TOH nihn*, is a hormone normally present in an inactive form in blood platelets (see BLOOD [Platelets]). When tissues are damaged, the platelets disintegrate, releasing serotonin. The serotonin constricts the blood vessels and prevents more bleeding. Serotonin is also present in the brain and intestinal tract. Some drugs affect brain function by preventing the release of serotonin. Other drugs stop nausea by blocking the action of serotonin on the intestinal tract. See also HORMONE. DAVID P. EARLE

SERPENT. See SEA SERPENT.

SERPENT MOUND. See OHIO (Places to Visit [Indian Mounds]).

SERPENTINE, *SIR pun teen*, is a mineral with the chemical composition $Mg_3Si_2O_5(OH)_4$. It occurs in two distinct forms. *Antigorite*, a flaky variety, is found in massive rocks. These rocks are often mottled in varying shades of green. When polished, these rocks have a marblelike appearance. Such serpentine is used as ornamental stone called *verd antique* or *serpentine marble*. *Chrysotile*, a fibrous variety, is the most important type of asbestos. This form of serpentine is mined in Canada, Russia, and South Africa. CORNELIUS S. HURLBUT, JR.

See also ASBESTOS (Types of Asbestos).

SERRA, JUNÍPERO (1713-1784), was a Franciscan missionary. He was born in Petra, Majorca, and joined the San Fernando missionary college in Mexico in 1749. Serra became famous as a preacher, and made long journeys on foot in spite of lameness. In 1767 he became the superior of the Franciscan missions in Lower California (a part of Mexico). He founded the first mission in Upper California (now California) in 1769. Serra's writings include the *Representación* and a *Diario*.

A statue of Junípero Serra represents California in Statuary Hall in the United States Capitol. FULTON J. SHEEN

SERTOMA INTERNATIONAL is a service organization of clubs in Canada, Mexico, Puerto Rico, and the United States. Its name comes from the slogan "Service to Mankind." Sertoma clubs provide scholarships, aid orphanages and other institutions, plan civic improvement, and sponsor other community service projects, such as hearing and speech service programs. The clubs also sponsor an annual Freedom Week and distribute copies of the Declaration of Independence and the Bill of Rights to school children. The organization has 32,000 members in over 850 clubs.

The organization was founded in 1912. It has headquarters at 1900 E. Meyer Boulevard, Kansas City, Mo. 64132. Critically reviewed by SERTOMA INTERNATIONAL

SERUM, *SEER um*, is the clear, fluid part of blood that is left after a clot forms. Serum is just like *plasma* (the total liquid part of the blood) except that it does not contain *fibrinogen*, a substance that causes clotting.

Serum contains such substances as salt, proteins, glucose, and fats. Samples of serum are used to help *diagnose* (determine) the medical problems of patients. Tests on blood serum are called *serologic tests*.

Serum proteins contain *antibodies* that the body produces to fight certain diseases and *toxins* (poisons). A serum containing antibodies that is taken from a person or animal and injected into a patient is called an

antiserum. Antiserums work against such diseases as diphtheria and *tetanus* (lockjaw). *Antitoxins* are certain kinds of antiserums.

Serum taken from a person who has recently recovered from a disease usually contains more than the normal amount of antibodies. This serum may help cure or prevent the disease. However, doctors have recently found a more efficient way of providing the antibodies to fight a disease. Instead of using the entire serum, they inject only a part of the serum called *gamma globulin*. Gamma globulin is a kind of protein that contains most of the blood's antibodies. Gamma globulin preparations are used to fight and prevent hepatitis, measles, mumps, and whooping cough.

Serum obtained from animals is easier to obtain and costs less than serum from human beings. But it is often less effective and more dangerous than human serum. A horse is usually used because it has a large amount of blood and produces many antibodies. Horse antiserums are used to prevent rabies and to treat persons bitten by poisonous snakes and black widow spiders. They are also used to treat *botulism* (food poisoning), gas gangrene, and rabies. However, some patients are *allergic* (extremely sensitive) to animal proteins, and may have serious reactions. SOLOMON GARB

See also ANTIBODY; PLASMA; BLOOD TRANSFUSION; ANTITOXIN; GAMMA GLOBULIN.

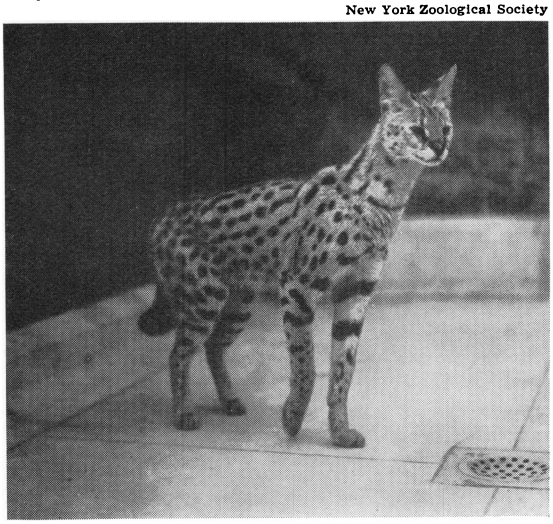
SERUM SICKNESS is a nonfatal illness that frequently follows an injection of animal serum (see SERUM). It is caused by a reaction between the protein of the injected serum and specific protective substances produced by the body.

Symptoms include hives, fever, asthma, and painful swollen joints. They usually appear within 5 to 10 days. The symptoms develop sooner and are usually more severe if the person has had a previous injection of a similar serum. R. B. CAPPS

SERVAL, *SUR vuhl*, is a large wildcat that lives in Africa, from the Cape of Good Hope north to Senegal and the Sudan. Its tawny, black-spotted fur is sold under the trade name of *tiger cat*. The male is from 3 to 4 feet (91 to 120 centimeters) long and stands 18 to 23 inches (46 to 58 centimeters) tall at the shoulder. It has a 12-inch (30-centimeter) tail and large ears. These animals are easy to tame if they are captured when young, but they are difficult to raise. They are usually taken in snares or are treed by dogs. They hide in bushes along riverbanks, waiting for their prey. They eat small fowl and other creatures up to the size of small antelopes. They generally hunt on the ground but are expert climbers and often go into the trees after birds.

The Serval has a head much like that of the domestic cat. The body markings are a combination of dots and stripes.

New York Zoological Society



Scientific Classification. The serval is a member of the cat family, *Felidae*. It is classified as genus *Felis*, species *F. serval*. ERNEST S. BOOTH

SERVANT is an employee who serves in a personal capacity for his employer. He performs such services as preparing food, caring for children, and other domestic duties. At one time, most servants lived in the homes of their employers. Now most servants work for wages at more or less regular hours, just as other employees do. During colonial days in America, indentured servants worked for masters as a means of paying off indebtedness. See also INDENTURED SERVANT. JOHN F. CUBER

SERVETUS, *sur VEE tuhs*, **MICHAEL** (1511-1553), was a Spanish physician and theologian. His description of the pulmonary circulation is considered a classic passage in physiology. He was born in Tudela, Spain, and studied medicine in Paris. He lectured in Paris, and then practiced medicine in several French cities. Civil and church authorities condemned Servetus for not conforming to accepted doctrines in his religious writings. John Calvin accused him of being a heretic, and he was burned at the stake. CAROLINE A. CHANDLER

SERVICE, ROBERT WILLIAM (1874-1958), a Canadian poet, won fame with such rollicking frontier ballads as "The Shooting of Dan McGrew" and "The Cremation of Sam McGee." Service became a productive writer of both prose and verse, but it was his verse that won wide popularity for its vigor and verve. *Songs of a Sourdough* (1907) established Service's reputation as a poet, and *The Trail of '98* (1910) became his most popular novel.

Service was born in Preston, England, and was educated at Hillhead High School in Glasgow, Scotland, and the University of Glasgow. He worked briefly as a bank clerk in Scotland, and then moved to Canada in 1905. After several years of wandering in the Canadian and American West, he returned to banking. His work as a bank clerk in Whitehorse and Dawson in the Yukon territory early in the 1900's gave him the material for his poems of the miners, hunters, and trappers of the Northwest. Before World War I, Service was a war correspondent in Europe. After the war broke out, he served as an ambulance driver. He lived in France during most of his later life, although he returned periodically to Canada. DESMOND PACEY

Robert Service

Press Association

SERVICE CLUB is an organization that works to improve the community. Service clubs sponsor community projects, conduct youth activities, support welfare services, and promote good citizenship. Most service clubs are made up of professional and business men or women. Important service clubs include Civitan International, International Association of Lions Clubs, Kiwanis International, Optimist International, Rotary International, and Sertoma International. WORLD BOOK has a separate article on each of these clubs.

SERVICE CROSS, DISTINGUISHED. See DECORATIONS AND MEDALS (Military Awards).

SERVICE MEDAL, DISTINGUISHED. See DECORATIONS AND MEDALS (Military Awards).

SERVICE ORGANIZATIONS, UNITED. See UNITED SERVICE ORGANIZATIONS.

SERVICE STATION. See PETROLEUM (Service Stations).

SERVICE VOCATIONS. See VOCATIONS (Fields).

SERVIUS TULLIUS, the sixth of the seven legendary kings of Rome, reigned from 578 to 534 B.C. Many of his deeds are legendary. Legend says his mother was a slave who served the wife of Tarquinius Priscus, a king of Rome. The queen, a prophetess, predicted greatness for Servius. Servius won the favor of the king, and married the king's daughter. He became king when the king died, and held the throne for 44 years.

Servius reorganized the state by placing citizens in *centuries* (voting groups) according to wealth. All people had some power, but the rich were the most powerful. Servius encouraged the *plebeians* (members of the lower class), and built many structures. An early wall and sewer, credited to Servius, were actually built later. Servius was murdered by his daughter and her husband, Tarquinius Superbus. HERBERT M. HOWE

SERVOMECHANISM, *SUR voh MEHK uh nihz uhm*, is a type of control system that detects and corrects errors. Industry uses servomechanisms to control automatic machines. On warships, servomechanisms aim guns, using information received from radar. Servomechanisms are also used to keep guided missiles on course.

In a servomechanism system, a signal from a *controller* is compared to a signal from the controlled mechanism. The difference between the two signals, usually called the *error signal*, is used to operate a *servodevice*. This mechanism moves or changes the controlled device until the difference in signal becomes zero or nearly zero. For example, the automatic pilot used in airplanes has a servomechanism that compares the desired course of the airplane to the actual course. The error signal represents any difference between the two, and is used to operate the airplane's controls until it is back on course. When the airplane is on course, the error signal is zero. See GYROPILOT.

Man also uses the principle of the servomechanism in everyday living. For example, the brain of a driver compares the actual position of his car on the road to the desired position. If the car moves off the road, the eye transmits a signal to the brain. The brain compares the desired position to the actual position seen by the eye. It directs the arms to rotate the steering wheel until the car is back on the road. OTTO A. UYEHARA

See also AUTOMATION.

SESAME, *SEHS uh mee*, is an herb grown in tropical countries. It is grown mainly for the oil obtained from its seeds. It originally grew in China, India, and Japan and has been cultivated in Mexico and the Southern United States. An annual, it grows about 2 feet (61 centimeters) high. Its leaves are oblong, and its tiny flowers are pink or white, depending on the species. Small capsules contain flat seeds that range from white to brown in color.

USDA

The Sesame Plant bears capsules that contain seeds.

The oil obtained from sesame seeds is straw-colored, and is similar to olive oil. It is used in salad dressings and in cooking. The seeds have a delicious taste and are used to flavor bread, biscuits, candy, and other delicacies.

Scientific Classification. The sesame plant belongs to the pedalium family, *Pedaliaceae*. The scientific name is genus *Sesamum*, species *S. indicum*. HAROLD NORMAN MOLDENKE

SESQUICENTENNIAL EXPOSITION, *SEHS kwih sehn TEHN ee uhl*, was held in Philadelphia in the summer of 1926 to mark the 150th anniversary of the signing of the Declaration of Independence. Almost 6 million persons visited the 1,000-acre (400-hectare) grounds of the Sesquicentennial Exposition.

SESSHU, *sehs shoo* (1419-1506), a Buddhist monk, was the greatest Japanese landscape painter in the tradition of Chinese ink drawing. His style is easy to recognize through its bold compositions, forceful drawing, and disregard of subtle modeling. His masterpiece is a long scroll showing Chinese river scenery. Sesshu learned his art by studying the works of Chinese ink masters of the 1200's. ALEXANDER C. SOPER

SESSIONS, ROGER (1896-), is one of the foremost American composers. His music, which is very complex and dissonant, is considered among the most significant work produced in the United States. It includes three symphonies, a piano concerto, an opera entitled *The Trial of Lucullus* (1947), two string quartets, a quintet, and other chamber music. Sessions was born in Brooklyn, N.Y. He lived in Europe from 1925 to 1933. Later, he taught in American universities. HALSEY STEVENS

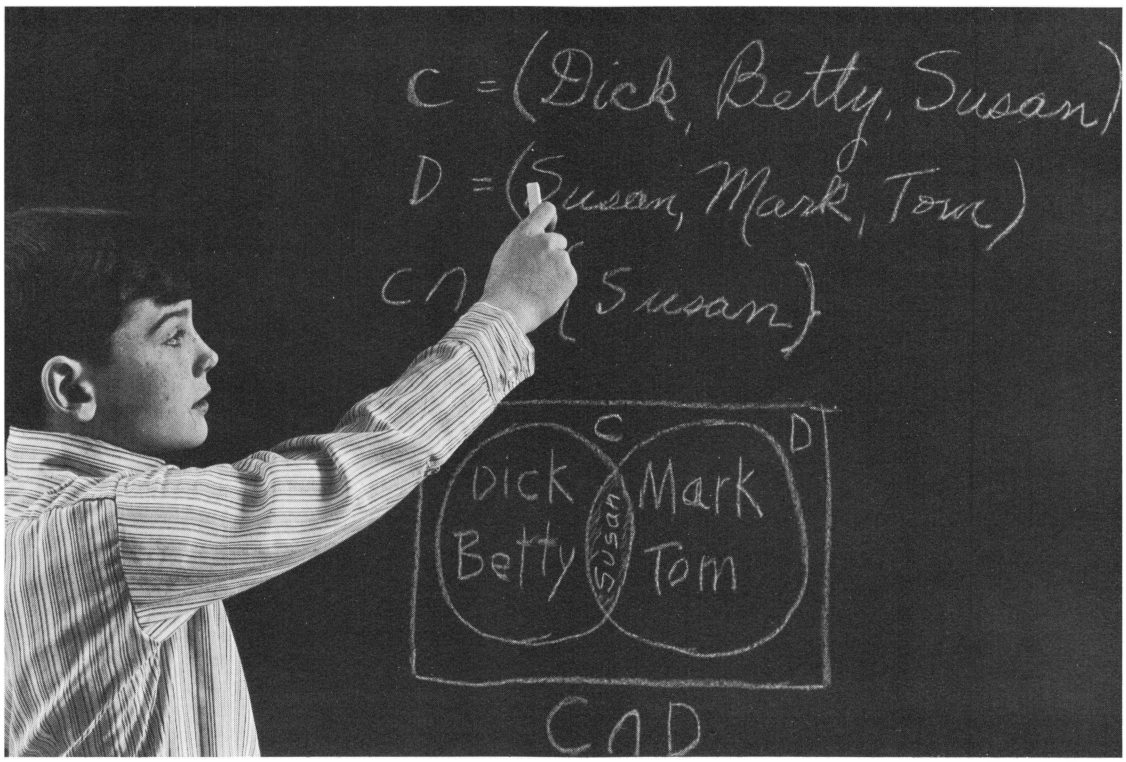
SESTET. See SONNET.

SESTOS. See ABYDOS.

SET was the ancient Egyptian god of evil. He was also known by the names Seth and Sutekh. He was a wicked and powerful god who often used witchcraft to achieve his aims. As god of the desert, he was responsible for the storms that blew from the Libyan Desert and damaged the farms and crops.

As the principle of evil, Set was in constant warfare with his brother Osiris, who represented the principle of goodness. Set eventually murdered Osiris. Set was represented by the head of a strange-looking animal that may have been a cross between a donkey and a pig. His most important center of worship was at Ombos in Upper Egypt. I. J. GELB

See also OSIRIS.



WORLD BOOK photo

Diagrams Help Solve Many Problems Involving Sets. To find out which members of one set are also members of the other set, the student draws a circle around the members of each set. Where the circles overlap, they show who—Susan, in this case—is a member of both sets.

SET THEORY

SET THEORY is a way of solving problems in mathematics and in *logic* (reasoning). By studying set theory, you can get a better understanding of arithmetic and of mathematics as a whole.

A *set* is a collection of objects or ideas. A family, a box of crayons, or a flock of sheep is a set of objects. The rules of a game or the even numbers from 10 to 20 are sets of ideas. The items that make up a set are *members* or *elements* of the set. A red crayon is a member of a set of crayons. The number 16 is a member of the set of even numbers from 10 to 20.

Mathematicians use letters to designate sets and the members of sets. Capital letters are used to name sets, and small letters are used to name the members of sets. For example, the letter C may stand for "the set of fifth-grade girls with curly hair." The letters m, s, and r would stand for the members of this set—Martha, Sara, and Ruth. To show that set C consists of Martha, Sara, and Ruth, you write: Set C = {Martha, Sara, Ruth} or simply $C = \{m, s, r\}$. A set is shown by enclosing the members in *braces* { }.

You may want to show that a member belongs to a certain set. For example, to show that Sara belongs to set C, you write $s \in C$, which is read: "*s is a member of C.*" If you want to show that Jean is not a member of set C, you write $j \notin C$, which means: "*j is not a member of C.*"

A set may also be defined in terms of its properties. A *property* is something that relates the members to one another. In the example above, C has three properties: (1) its members are girls, (2) its members are in the fifth grade, and (3) its members have curly hair. To show these properties, you write: $C = x|x$ is a fifth-grade girl with curly hair. This statement is read: "C is the set of all members, x, such that x is a fifth-grade girl with curly hair." The vertical line between the x's means "such that."

Kinds of Sets

In working with sets, it is important to be able to compare one set with another. Mathematicians have

Charlotte W. Junge, the contributor of this article, is Professor of Education at Wayne State University and Assistant Editor of The Arithmetic Teacher.

given names to various kinds of sets to aid in such comparisons. The names refer to the number of members in a set and to relationships between sets. Ten main kinds of sets are (1) finite sets, (2) infinite sets, (3) empty sets, (4) single element sets, (5) equivalent sets, (6) equal sets, (7) overlapping sets, (8) disjoint sets, (9) universal sets, and (10) subsets. Every set can be called by several of these names. For example, equivalent sets can be finite and also disjoint.

Finite Sets and Infinite Sets. A *finite* set has a definite number of members. "Three cats" and "three thousand head of cattle" are finite sets. To describe a finite set, you list all the members of the set. For example, if set W is the set of all counting numbers greater than 4 and less than 10, you write: $W = \{5, 6, 7, 8, 9\}$. An *infinite* set has an endless number of members. The numerals you use in counting form an infinite set: 1, 2, 3, 4, 5, and so on without end. It is impossible to list all the members of an infinite set. To describe such a set, you list the first few members and write three dots to show that the number of members is endless:

$$\{1, 2, 3, \ldots\}$$

Empty Sets have no members. They also are called *null sets*. The following sets show which students were absent from school on three days. Monday: Paul, Frances. Tuesday: Joe. Wednesday: No one absent.

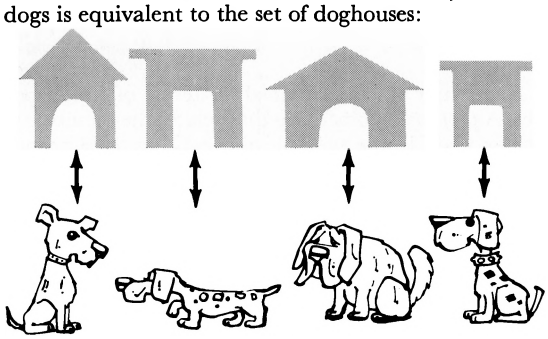
The Monday set of absentees has two members and the Tuesday set has one member. The Wednesday set has no members, so it is an empty set. You show an empty set by leaving a blank space between a pair of braces, or by writing the symbol $\emptyset$:

Students absent on Wednesday $= \{\} = \emptyset$

Single Element Sets contain only one member. In the example above, the set of students absent on Tuesday is a single element set.

Students absent on Tuesday $= \{\text{Joe}\} = \{1\}$

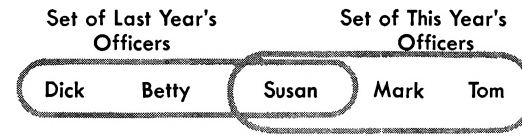
Equivalent Sets have the same number of members. You can match their members one for one against each other. If the number of desks in a classroom is the same as the number of students, the set of desks is equivalent to the set of students. In the illustration below, the set of dogs is equivalent to the set of doghouses:



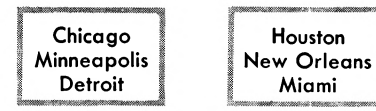
To show that sets A and B are equivalent, you write: $A \leftrightarrow B$. The symbol $\leftrightarrow$ means "is equivalent to." It shows that the members of both sets can be matched one for one, as in the illustration. But if you have a set of five dogs and a set of four dog houses, then the sets are not equivalent and you would write $A \not\leftrightarrow B$, which is read: "A is not equivalent to B."

Equal Sets have the same members. Suppose that C stands for the set of students who received 100% on a spelling test: $C = \{\text{Steve, Mark, Joan, Tom}\}$. Suppose also that D represents the set of students who received 100% on an arithmetic test: $D = \{\text{Tom, Joan, Mark, Steve}\}$. Then, C is equal to D because both sets have the same members. To show they are equal, you write: $C = D$.

Overlapping Sets and Disjoint Sets. *Overlapping* sets have some members in common. Suppose that Dick, Susan, and Betty were class officers last year, and that Mark, Susan, and Tom are class officers this year. Susan belongs to both sets. The sets overlap, as shown in the following diagram:

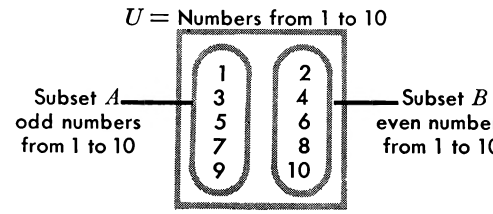


Disjoint sets have no members in common. The illustration below shows a pair of disjoint sets:



Universal Sets consist of all members being considered at any one time. Such a set may be called a *universe*. It is usually represented by the letter U. Suppose that in a certain problem you are working only with the numbers from 1 to 10. The universal set then has the following members: $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. In another problem, the universe might be "all even numbers," and in still another it might be "all students in sixth grade."

Subsets are contained within other sets. For example, the set "all sixth-graders with brown eyes" is a subset contained in the set "all sixth-graders." Two subsets of the set of numbers from 1 to 10 are shown below.



To show that A and B are subsets of U, you write $A \subset U$ and $B \subset U$. The symbol $\subset$ means "is included in."

Note that subsets A and B are finite sets because they have a definite number of members. They also are equivalent sets because you can match their members one for one against each other. They also are disjoint sets because no members belong to both A and B.

Diagraming Sets

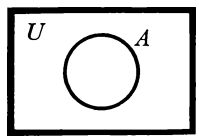
Mathematicians often use diagrams to show relationships and to solve problems. In the 1700's, Leonhard Euler, a Swiss mathematician, first used circles to represent sets and the relationships between them. In 1894, John Venn, an English scholar, included rectangles in these diagrams.

In these diagrams, called *Venn diagrams* or *Euler's circles*, rectangles and circles are used to represent sets. A circle of a certain size may stand for a finite set, an infinite set, or an empty set. Two circles of the same size may represent equivalent sets or sets with different numbers of members. Therefore, there are no specific Venn diagrams for finite sets, infinite sets, empty sets, single element sets, or equivalent sets.

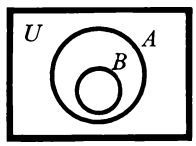
Diagram for Universal Sets is a rectangle labeled with the letter U. This diagram stands for all the mem-

bers you are considering in a particular problem. It may represent "all counting numbers," "the months of the year," or any other such group.

Diagram for Subsets is a circle labeled with the letter that represents the set. Suppose that the universal set U stands for all the students in Patrick Henry school, and that the subset A is all the sixth-grade students in Patrick Henry school. You draw the circle for A entirely within the rectangle for U because every member of A is also a member of U.

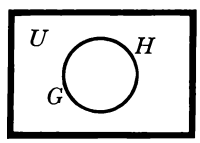


To show a subset of A, you draw another circle inside A. Suppose B stands for the boys in the sixth grade at Patrick Henry school. Here is the way you would add set B to the Venn diagram above:



You draw the circle for B entirely within the circle for A because every member of B is also a member of A.

Diagram for Equal Sets is a single circle labeled with two or more letters. Each letter stands for a set. The

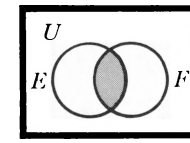


single circle shows that each set has exactly the same members. You can think of the circle as two or more circles that overlap completely. For example, suppose U is the set of numbers from 1 to 10. Let G be the set of numbers used in counting to 10 by 2's. Let H be the set of numbers from 1 to 10 that can be divided evenly by 2. You can list the members of these sets as follows:

$$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$
$$G = \{2, 4, 6, 8, 10\}$$
$$H = \{2, 4, 6, 8, 10\}$$

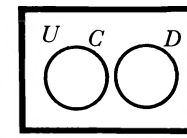
Sets G and H have exactly the same members, so you represent both with a single circle in the diagram.

Diagram for Overlapping Sets consists of overlapping circles. This diagram shows that some of the



members of E also belong to F. Suppose U is the set of all students everywhere. Let E be the set of all girl students, and let F be the set of all students at Patrick Henry school. The shaded portion of the diagram represents the set of girl students who attend Patrick Henry school.

Diagram for Disjoint Sets consists of two or more separate circles.



Suppose U stands for all sixth-grade students at Patrick Henry school. Let set C be the boys in sixth grade, and set D the girls in sixth grade. Both C and D are subsets of U. But C and D are disjoint sets because no member belongs to both of them.

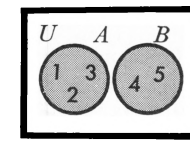
Operations with Sets

Three basic operations are used to solve problems involving sets: (1) union, (2) intersection, and (3) complement. These operations resemble arithmetic operations, such as addition and subtraction. In general, you work with two sets at a time, and produce a third set. The terms *union*, *intersection*, and *complement* name the operations and the sets that result from the operations.

Union of Sets includes all members of two sets without repeating any members. The symbol for union is $\cup$, which is called "cup." To show the union of sets A and B, you write $A \cup B$, which is read: "*A union B*."

Union of Disjoint Sets:

$A = \{1, 2, 3\}$
$B = \{4, 5\}$
$A \cup B = \{1, 2, 3, 4, 5\}$

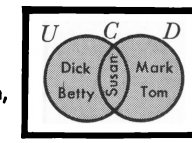


$A \cup B$

The union of sets A and B includes all the members of A and B. In the Venn diagram, $A \cup B$ is represented by the shaded portions taken together. Note that A has 3 members, and B has 2. So $A \cup B$ has $3 + 2 = 5$ members. In the union of disjoint sets, the number of members equals the sum of the members in the sets.

Union of Overlapping Sets:

$C = \{\text{Dick, Betty, Susan}\}$
$D = \{\text{Susan, Mark, Tom}\}$
$C \cup D = \{\text{Dick, Betty, Susan, Mark, Tom}\}$



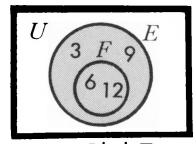
$C \cup D$

The shaded portion of the diagram represents $C \cup D$. If you add the number of members in sets C and D, you get 6. But when you list the members of $C \cup D$, you write Susan's name only once. As a result, set $C \cup D$

has only 5 members. In the union of overlapping sets, the total number of members is always less than the sum of the members in the sets.

Union of a Set and Its Subset:

$E = \{3, 6, 9, 12\}$
$F = \{6, 12\}$
$E \cup F = \{3, 6, 9, 12\}$



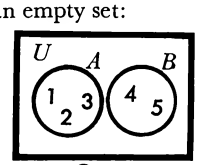
$E \cup F$

When you list the members of $E \cup F$, you write 6 and 12 only once, because these members belong to both sets. So $E \cup F$ has exactly the same members as E. The shaded portion of the Venn diagram represents $E \cup F$. This portion lies entirely within the circle for E, showing that $E \cup F$ equals E. The union of a set and its subset always has exactly the same total number of members as the set itself.

Intersection of Sets is a set that includes only those members that belong to both sets. For example, in the sets $G = \{1, 2, 3\}$ and $H = \{2, 3, 4\}$, the intersection of G and H is the set $\{2, 3\}$. These members belong to both G and H. The symbol for intersection, $\cap$, is called "cap." To show the intersection of G and H, you write $G \cap H$, which is read: "*G intersect H.*"

Intersection of Disjoint Sets is an empty set:

$A = \{1, 2, 3\}$
$B = \{4, 5\}$
$A \cap B = \{\} = \phi$

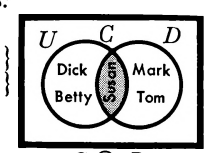


$A \cap B = \phi$

The intersection of A and B is an empty set because the two sets have no members in common.

Intersection of Overlapping Sets:

$C = \{\text{Dick, Betty, Susan}\}$
$D = \{\text{Susan, Mark, Tom}\}$
$C \cap D = \{\text{Susan}\}$

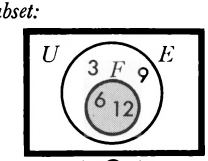


$C \cap D$

Only one member—Susan—belongs to both C and D. Therefore, Susan is the intersection of C and D, as shown by the shaded area in the Venn diagram.

Intersection of a Set and Its Subset:

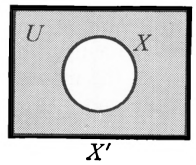
$E = \{3, 6, 9, 12\}$
$F = \{6, 12\}$
$E \cap F = \{6, 12\}$



$E \cap F$

Set F is a subset of E because every member of F is also a member of E. The intersection of E and F is the set $\{6, 12\}$. The shaded portion of the Venn diagram shows $E \cap F$. This portion lies entirely within the circle for F, showing that $E \cap F$ equals F.

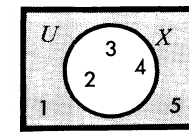
Complement of a Set is represented by the shaded portion of the Venn diagram below.



X'

In the diagram, X is a subset of the universal set U. The shaded portion represents the set of members that belong to U, but not to X. This set is called the complement of X. The symbol X' stands for the complement of X. For example:

$U = \{1, 2, 3, 4, 5\}$
$X = \{2, 3, 4\}$
$X' = \{1, 5\}$



The members 1 and 5 belong to U, but not to X. Therefore, the complement of X is $\{1, 5\}$, as shown by the shaded portion of the Venn diagram.

Using Set Theory

In Arithmetic, set theory helps you understand some of the basic ideas of working with numbers. For example, you can learn the meaning of *number* by matching the members of two sets against one another.

$A = \{a, b, c, d\}$
$\updownarrow\ \updownarrow\ \updownarrow\ \updownarrow$
$B = \{e, f, g, h\}$

Sets A and B are equivalent. The members are different, but something about the sets is the same. This "something" is the *number* of members in each set. The name you use for any number is called a *numeral*. Thus, the numeral 4 tells you the number of members in either set A or set B. Before ancient man learned to count, he used the idea of equivalent sets to keep track of his possessions. See NUMERATION SYSTEMS (History).

Set theory also explains why you can add or multiply numbers in any order and still get the same answer. For example, $2 + 3$ is equivalent to $3 + 2$. Addition in arithmetic is the same as the union of disjoint sets. Here is the way you use set theory to represent the problems $2 + 3$ and $3 + 2$:

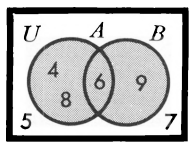
$C = \{h, i\}$ (2 members)
$D = \{j, k, l\}$ (3 members)
$C \cup D = \{h, i, j, k, l\}$ ($2 + 3 = 5$ members)
$\updownarrow\ \updownarrow\ \updownarrow\ \updownarrow\ \updownarrow$
$D \cup C = \{j, k, l, h, i\}$ ($3 + 2 = 5$ members)

The arrows show that $C \cup D$ and $D \cup C$ contain the same number of members. Therefore, $2 + 3$ is equivalent to $3 + 2$. Mathematicians say that addition follows the *commutative law* (meaning *law of order*) because numbers can be added in any order to give the same result. Mathematicians also use set theory to explain other similar laws of working with numbers.

In Algebra, sets are helpful in several ways. Suppose that in a certain problem the letter x stands for any number from 1 to 10. You call x a *variable*, and you call the set of numbers from 1 to 10 the *domain of the variable*. The solution of the equation is the set of all numbers in the domain that make a true statement when substituted for x. Such a set is called a *solution set*.

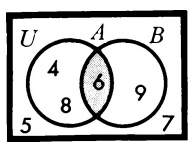
Suppose that in a certain problem the domain of x is $U = \{4, 5, 6, 7, 8, 9\}$. You are asked to find the values of x that satisfy the condition: x can be divided evenly by 2. To solve this problem, divide each member of the domain by 2. You find that 4, 6, and 8 can be divided evenly by 2, but 5, 7, and 9 cannot. Therefore, the solution set is $\{4, 6, 8\}$. Depending on the problem, a solution set may be an empty set, or it may have any number of members. See ALGEBRA (Learning Algebra).

You can also use set operations, such as union and intersection, to understand and to solve certain algebra problems. For example, suppose the domain of x is $U = \{4, 5, 6, 7, 8, 9\}$. Find the values of x that satisfy the two conditions: (1) x can be divided evenly by 2, *or* (2) x can be divided evenly by 3. When two conditions are connected by the word *or*, the solution set must include all values of x that satisfy either the first condition or the second. You find that 4, 6, and 8 can be divided evenly by 2. Therefore, the solution set for the first condition is $A = \{4, 6, 8\}$. You can divide 6 and 9 evenly by 3, so the solution set for the second condition is $B = \{6, 9\}$. The solution set for the whole problem is $\{4, 6, 8, 9\}$, because each of these numbers satisfies either the first condition or the second. This solution set is the union of the overlapping sets $A = \{4, 6, 8\}$ and $B = \{6, 9\}$ as shown in the diagram below:



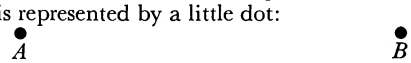
$A \cup B$

When two conditions of a problem are connected by the word *and*, the solution set must include all values of x that satisfy both the first condition and the second condition. For example, let $U = \{4, 5, 6, 7, 8, 9\}$. Find the values of x that satisfy the two conditions: (1) x can be divided evenly by 2, *and* (2) x can be divided evenly by 3. Again, the solution sets are $A = \{4, 6, 8\}$ and $B = \{6, 9\}$. But 6 is the only value that can be divided evenly both by 2 and by 3. The solution set for this problem is $\{6\}$, because only this value of x satisfies both conditions. This solution set is the intersection of the two sets $A = \{4, 6, 8\}$ and $B = \{6, 9\}$, as shown in the following diagram:

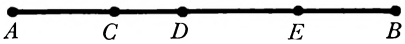


$A \cap B$

In Geometry, the sets studied are sets of points. The diagram below shows a set of two points, A and B. Each point is represented by a little dot:

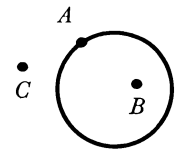


When you connect these two points with a straight line, you form a *line segment*. The notation $\overline{AB}$ is used to represent this segment. Points A and B are the *end points* of the segment. But you can imagine many other points, such as C, D, and E, on the same segment. Thus, segment $\overline{AB}$ consists of points A and B and the set of all points that lie between them.

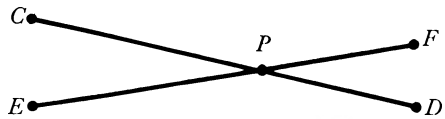


In a similar way, you can think of the set of all points on a sheet of paper, on a wall, or on any other flat surface. Such a set of points makes up a *plane*. On a plane, you can draw simple *closed curves* by starting at any point and returning to that point without lifting your pencil. Examples of simple closed curves include circles, squares, and triangles. A circle is a closed curve, but a half circle is not.

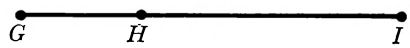
A closed curve separates a plane into three sets of points: (1) those outside the curve, (2) those inside the curve, and (3) those on the curve itself. The interior of any simple closed curve is called a *region*. The curve is the *boundary* of the region. The region and the boundary are called a *closed region*. In the diagram, point A belongs to the set of points on the boundary, B belongs to the set of points inside the circle, and C belongs to the set of points outside the circle.



You can use the union and intersection operations to describe the relationship between geometrical figures. In the diagram below, two line segments $\overline{CD}$ and $\overline{EF}$ cross at point P. In terms of sets, you would say that P is the intersection of the two sets of points that make up lines $\overline{CD}$ and $\overline{EF}$. You can write: $\overline{CD} \cap \overline{EF} = \{P\}$.



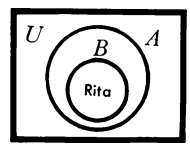
In the next diagram, the segment $\overline{GI}$ is made up of two segments, $\overline{GH}$ and $\overline{HI}$. The set of points in $\overline{GI}$ is the union of the sets of points in $\overline{GH}$ and $\overline{HI}$. You can show this relationship as follows: $\overline{GH} \cup \overline{HI} = \overline{GI}$.



In Logic, set theory can help you form conclusions based on statements called *premises*. Here is the way you would use sets to illustrate three simple logical conclusions. In each of these examples, the universal set is the set of all students at Patrick Henry school.

1. *First Premise:* All sixth-grade girls are members of the school glee club. *Second Premise:* Rita is a sixth-grade girl. *Conclusion:* Rita is a member of the school glee club.

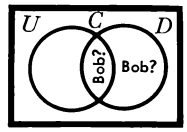
Let A be the set of members in the school glee club, and let B be the set of girls in sixth grade. According to the first premise, B is a subset of A. That is, every member of B is a member of A. According to the second premise, Rita belongs to set B. Therefore, Rita must also belong to set A.



2. *First Premise:* Some fifth-graders take music lessons. *Second Premise:* Bob is a fifth-grader. *Conclusion:* Bob might take music lessons, or he might not.

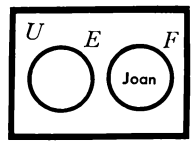
Let C be the set of students who take music lessons, and let D be the set of fifth-graders. According to the first premise, some members of C are members of D. Therefore, the sets overlap. The intersection includes those fifth-graders who take music lessons. According to the second premise, Bob belongs to set D. But it is impossible to tell whether Bob belongs to that portion of

set D that intersects set C. Therefore, the only conclusion you can reach is that Bob might take lessons, or he might not.



3. *First Premise:* No girls are members of the school baseball team. *Second Premise:* Joan is a girl. *Conclusion:* Joan is not a member of the school baseball team.

Let F be the set of girl students, and let E be the set of players on the school baseball team. According to the first premise, the two sets are disjoint. That is, no members of F belong to E. According to the second premise, Joan belongs to set F. Therefore, Joan cannot be a member of E.



History

The set theory studied in elementary and high schools developed from two mathematical discoveries of the 1800's—*symbolic logic* and *the theory of sets*.

Symbolic logic is a way of using mathematical symbols and operations to solve problems in logic. George Boole (1815-1864), an Irish mathematician, established the basis of this technique in the 1840's.

In the 1870's, the German mathematician Georg Cantor (1845-1918) applied some of the ideas of symbolic logic to sets of numbers. He formed a theory that he called "the theory of sets." Cantor developed this theory because of his interest in infinite quantities. For example, he showed how the members of certain infinite sets could be matched one for one against each other. The set of counting numbers can be matched against the set of even numbers as follows:

1, 2, 3, 4, 5, and so on;
↕ ↕ ↕ ↕ ↕
2, 4, 6, 8, 10, and so on.

Both sets are infinite and equivalent, even though the second is a part of the first.

In the 1950's and 1960's, mathematicians and educators recognized that the ideas of set theory could help students understand the principles of arithmetic and mathematics. The study of sets became a part of what was called the "new mathematics." By studying sets, students learned the meaning of such basic ideas as *number* and *numeral*. They also learned to apply mathematics to the field of logic.

In the 1970's, mathematicians and educators continued to stress the new mathematics. But they also gave added emphasis to solving problems and learning basic computational skills. CHARLOTTE W. JUNGE

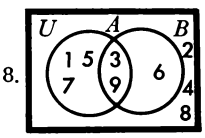
Set Theory Problems

1. $A = \{3, 4, 5, 6, 7, 8, 9\}$
   $B = \{4, 6, 8, 10\}$
   List the members of $A \cup B$.
2. List the members of $G = x|x$ is an odd number greater than 11 and less than 22.
3. $C = \{\text{all factors of } 6\}$
   $D = \{\text{all factors of } 12\}$
   List all members of $C \cap D$.
4. Give the union and the intersection of each pair of these sets:
   a. $A = \{\frac{1}{2}, \frac{1}{4}, \frac{1}{6}\}$; $B = \{\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}\}$
   b. $X = \{1, 3, 5, 7\}$; $Y = \{2, 4, 6, 8\}$
5. Which of these sets are equal?
   $\{a, b, c, d\}$
   $\{1, 2, 3, 4\}$
   {Tom, Bill, Jack}
   $\{4, 2, 3, 1\}$
6. Which of these sets are equivalent?
   {Red, White, Blue}
   $\{3, 6, 9\}$
   {Red, Yellow, Green, Orange}
   $\{a, b, c, d, e\}$
7. $A = \{\text{The set of counting numbers}\}$. List the members of set A.
8. Draw a Venn diagram for the following problem: $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. Find the values of x that satisfy these two conditions: (1) x is an odd number, *and* (2) x can be evenly divided by 3.
9. Draw a Venn diagram for the following problem: Some insects are social insects and live in colonies. Ants live in colonies. Ants are social insects.
10. $U = \{\text{Square, Rectangle, Circle, Triangle}\}$
    $D = \{\text{Circle}\}$
    List the members of D'.

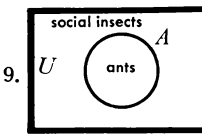
Answers

1. $A \cup B = \{3, 4, 5, 6, 7, 8, 9, 10\}$
2. $G = \{13, 15, 17, 19, 21\}$
3. $C \cap D = \{1, 2, 3, 6\}$
4. $A \cup B = \{\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}\}$ $A \cap B = \{\frac{1}{2}, \frac{1}{4}\}$
   $X \cup Y = \{1, 2, 3, 4, 5, 6, 7, 8\}$ $X \cap Y = \{\} = \emptyset$
5. $\{1, 2, 3, 4\} = \{4, 2, 3, 1\}$
6. {Red, White, Blue} and {3, 6, 9}
7. $\{1, 2, 3, 4 \ldots\}$

8.



9.



10. $D' = \{\text{Square, Rectangle, Triangle}\}$

Related Articles in WORLD BOOK include:

Algebra
Arithmetic
Boolean Algebra
Geometry
Logic
Mathematics
Numeration Systems

Outline

I. Kinds of Sets
- A. Finite Sets and Infinite Sets
- B. Empty Sets
- C. Single Element Sets
- D. Equivalent Sets
- E. Equal Sets
- F. Overlapping Sets and Disjoint Sets
- G. Universal Sets
- H. Subsets

II. Diagraming Sets
- A. Diagram for Universal Sets
- B. Diagram for Subsets
- C. Diagram for Equal Sets
- D. Diagram for Overlapping Sets
- E. Diagram for Disjoint Sets

III. Operations with Sets
- A. Union of Sets
- B. Intersection of Sets
- C. Complement of a Set

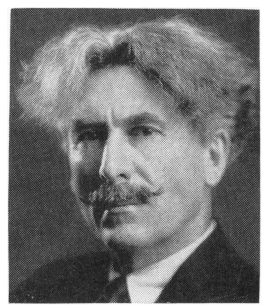
IV. Using Set Theory
- A. In Arithmetic
- B. In Algebra
- C. In Geometry
- D. In Logic

V. History

SETH. See ADAM AND EVE.

SETI I, *SEH tee* (reigned about 1309-1291 B.C.), was a king of ancient Egypt. Early in his reign he conducted two campaigns in Syria in an effort to check the advance of the Hittites and to re-establish the empire of Thutmose III in Palestine and Syria. Seti built the beautiful temple of Abydos, and began the Great Hypostyle Hall (hall of columns) at Karnak, which was completed by his son Ramses II. His tomb, the most splendid one in the Valley of the Tombs of the Kings, was discovered in 1817, and his mummy, together with that of Ramses II, was found in 1881, in another tomb near Dayr al Bahri. RICARDO A. CAMINOS

SETON, ERNEST THOMPSON (1860-1946), was the pen name of a popular writer and illustrator of animal and woodcraft books for boys. He was active in founding the Boy Scouts of America, wrote the first Scout manual, and was Chief Scout for five years. He also founded the Woodcraft Indians, an organization of boys and girls.



Ernest Thompson Seton

Seton was born Ernest Seton Thompson in South Shields, England, and spent his boyhood in Canada. He studied art in England, then returned to Canada as a government naturalist.

Seton later went to New York City, where he won fame with *Wild Animals I Have Known* (1898). He also wrote *Animal Heroes* (1905), and *Rolf in the Woods* (1911). JEAN THOMSON

SETON, SAINT ELIZABETH ANN (1774-1821), was the first person born in the United States to be recognized as a saint by the Roman Catholic Church. She was *canonized* (declared a saint) in 1975. Saint Elizabeth Ann Seton, who is also called Mother Seton, founded the Sisters of Charity, the first Catholic religious community that originated in the United States. She also pioneered in Catholic education in the United States.

Mother Seton was born Elizabeth Ann Bayley in New York City. In 1794, she married William M. Seton, a wealthy New York City shipping merchant. The couple had five children. Seton died in 1803, and his widow joined the Catholic Church two years later.

St. Joseph Provincial House, Emmitsburg, Maryland

Elizabeth Ann Seton

In 1808, Elizabeth Seton settled in Baltimore and established the Paca Street School, the first Catholic elementary school in the United States. She took religious vows in 1809 and founded the Sisters of Charity in Emmitsburg, Md., that same year. In 1814, she established the Orphan Asylum of Philadelphia, the nation's first Catholic child-care institution. Her feast day is January 4. MARGARET DOWLING

SETON HALL UNIVERSITY. See UNIVERSITIES AND COLLEGES (table).

SETON HILL COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SETTER is a long-haired hunting dog. It is used to search for such birds as quail and partridge. There are three recognized breeds in the setter family: *English; Gordon;* and *Irish*. All have silky coats, expressive eyes, and heavy muzzles. They are intelligent and gentle. Breeders in the United States classify setters as sporting dogs. The setter was developed from the old "setting spaniel." Setters are about the same size and shape as pointers, but have the spaniel's long hair.

A setter hunts game in the same way that pointers do (see POINTER). It ranges the field until it smells game. Then it comes to a *point*, with its nose pointing at the game, its body stiff, and its tail out straight or raised a little. Sometimes it lifts one front paw while pointing. The dog holds its point until the hunter *flushes* the game (makes it move from its hiding place). After the shot, the setter brings back the game. MAXWELL RIDDLE

See also DOG (color pictures: Sporting Dogs); ENGLISH SETTER; GORDON SETTER; IRISH SETTER.

SETTLEMENT HOUSE is an institution that tries to improve living conditions in city neighborhoods. A settlement house, also known as a *social settlement*, offers programs to fit the needs of people in its community. These programs include clubs for people of all ages, adult education classes, nurseries, and recreational activities. Most settlement houses have professional social workers and volunteers on their staff.

The first settlement house, Toynbee Hall, was founded in London in 1884 by a group of Oxford University students. In 1886, Stanton Coit, an American social reformer, established the first settlement house in the United States—University Settlement in New York City. Three years later, Jane Addams and Ellen Gates Starr opened Hull House in Chicago.

The National Federation of Settlements and Neighborhood Centers provides information services for settlement houses. The organization also helps settlements throughout the United States work together to support civil rights and fair employment practices. More than 300 settlement houses belong to the federation, which was established in 1911. ELAINE A. SWITZER

See also ADDAMS, JANE; HULL HOUSE; SOCIAL WORK; TOYNBEE (Arnold); WALD, LILLIAN D.

SEURAT, *suh RAH,* **GEORGES** (1859-1891), was a French artist who developed a system of painting called *pointillism*. Instead of using brushstrokes, Seurat painted uniform-sized dots of brilliant color side by side. Seen from a distance, the dots seem to merge and suggest other equally bright colors. Pointillism resulted in simplified forms to the extent that human figures appear impersonal and robotlike. These qualities appear in Seurat's *Sunday Afternoon on the Island of La Grande Jatte* (1886). It is reproduced in color in the PAINTING article.

Seurat was influenced by the impressionist painters, especially Claude Monet and Camille Pissarro. He used the bright colors of the impressionists and also their subjects—artists' studios, circus scenes, and harbors and seashores. But Seurat rejected the casual, relaxed

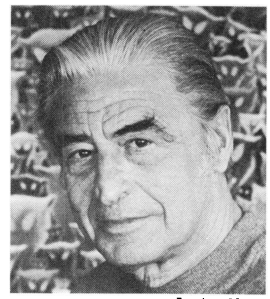
approach of the impressionists and their attempts to portray what the eye sees at a glance. To find a more controlled, scientific approach, Seurat studied the theories on color and light of the French physicist Eugène Chevreul and the French artist Eugène Delacroix.

When *La Grande Jatte* appeared in an exhibition of impressionist art in 1886, it attracted several painters to pointillism. As a group, these painters became known as *neoimpressionists*. They included Henri Cross, Camille Pissarro, and Paul Signac, the spokesman of the movement. The neoimpressionists influenced many painters of the early 1900's, including the fauves, the futurists, and the German expressionists.

Seurat was born in Paris. He kept to himself, and few details are known of his personal life. He painted almost constantly but completed few works. Seurat died of diphtheria at the age of 31. ROBERT F. REIFF

See also IMPRESSIONISM (Postimpressionism).

SEUSS, *SOOS*, DR. (1904-), is the pen name of Theodor Seuss Geisel, an American cartoonist and writer of humorous verse for children. He wrote delightful nonsense fantasies and accompanied them with his own illustrations. His books for children include *And To Think That I Saw It on Mulberry Street* (1937), *The King's Stilts* (1939), *Horton Hatches the Egg* (1940), *The Cat in the Hat* (1957), and *Green Eggs and Ham* (1960). He also worked as a magazine illustrator and humorist, an advertising artist and writer, and a public relations specialist. He was born in Springfield, Mass. E. HUDSON LONG



Lester Sloan

Dr. Seuss

See also LITERATURE FOR CHILDREN (picture: *The Cat in the Hat*).

SEVASTOPOL, *suh VAS tuh pohl* (pop. 236,000), lies on the Black Sea, in the southwestern part of the Crimean Peninsula in Russia. For location, see RUSSIA (political map). Its large harbor has made it the most important naval base on the Black Sea. The 11-month siege of the city in 1854 and 1855 marked the chief battle of the Crimean War. Sevastopol was attacked again in World War I. An eight-month siege during World War II reduced the city to ruins, but it has been largely rebuilt. THEODORE SHABAD

SEVEN BASIC FOODS. See NUTRITION.

SEVEN CITIES OF CIBOLA. See CIBOLA, SEVEN CITIES OF.

SEVEN DAYS, BATTLES OF THE. See CIVIL WAR (The Peninsular Campaign; table: Major Battles).

SEVEN PINES, BATTLE OF. See CIVIL WAR (The Peninsular Campaign; table: Major Battles [Fair Oaks]).

SEVEN SEAS is an ancient term describing all the seas and oceans of the world. Many people believe the term means the Arctic, Antarctic, North and South Pacific, North and South Atlantic, and Indian oceans. However, the phrase has no literal meaning, and it was used before some of the oceans were known to exist.

SEVEN SLEEPERS OF EPHESUS were seven Christian youths in an old legend who were said to have fled to the mountains near Ephesus in Asia Minor to escape the persecution of the Emperor Decius in about A.D. 251. Pursuers discovered their hiding place and blocked the entrance. Two hundred years later, a shepherd stumbled upon the cave and discovered seven youths asleep. When he awakened them, they believed that only a night had passed. One of them went to Ephesus for food and offered to pay for it with coins 200 years old. He was arrested as a thief of hidden treasure. But Emperor Theodosius II believed a miracle had taken place, and led the youth in a triumphant procession to the cave. Later, he had a great church and graveyard built to mark the spot. The seven sleepers lived for only a short time. All died at the same moment, and were buried where they had slept.

In 1928, Franz Miltner, an Austrian archaeologist, found a tomb near Ephesus which shows that the tale of the Seven Sleepers has some basis in fact. Theodosius' ancient church had been covered by other churches, and was discovered only by accident. The legend of the Seven Sleepers began in Syria and appeared in European literature in the A.D. 500's. It was a favorite theme in the art of the Middle Ages, and is told in the Koran, the Moslem holy book. THOMAS A. BRADY

SEVEN WEEKS' WAR, also called the AUSTRO-PRUSSIAN WAR, took place between June and August, 1866. Prussia fought against other German states and Austria. Otto von Bismarck, chancellor of Prussia, engineered the war as part of his campaign to force Austria out of the German Confederation and make Prussia the dominant power in Germany.

A dispute over the Danish duchies of Schleswig and Holstein furnished the immediate cause of the war. Austria, joined by the German states of Hesse, Saxony, and Hanover, declared war on Prussia on June 14, 1866. Bismarck secured the help of Italy. He also persuaded France to remain neutral by suggesting vaguely that France would be given new territory if Prussia won the war.

Prussia was outnumbered. But the strategic leadership of General Helmuth von Moltke, the use of the fast-firing "needle gun," and rapid troop maneuvers on the new railroads enabled the Prussians to win a series of quick victories. The greatest of these was the crushing defeat of the Austrians at the Battle of Königgrätz (also called Sadowa) on July 3.

The peace treaty ending the war was signed in Prague on August 23. According to the terms of the treaty, Austria had to give Venetia to the new kingdom of Italy and pay a small amount of money to Prussia. In addition, Austria was excluded from German affairs, and it was never again a power in Germany. The treaty also dissolved the old German Confederation, and permitted Prussia to form a new confederation without Austria. Bismarck organized the North German Confederation in 1867, which was dominated by Prussia. Prussia annexed outright Schleswig-Holstein, the kingdom of Hanover, the duchies of Nassau and Hesse-Cassel, and the free city of Frankfurt. ROBERT G. L. WAITE

See also BISMARCK; GERMANY (The Unification of Germany); MOLTKE (Count Helmuth Karl).

SEVEN WONDERS OF THE WORLD is a listing of notable objects in the world. The practice of listing the seven wonders began in ancient times, when Greeks and Romans compiled lists of memorable things that travelers should see. There were many lists compiled that included many different wonders. But all the lists of ancient wonders included only man-made objects that were considered notable because of their size or some other unusual quality.

Since that time, others—usually writers, explorers, and world travelers—have compiled lists of the Seven Natural Wonders and the Seven Modern Wonders. This article lists the most commonly mentioned seven ancient, natural, and modern wonders of the world.

The Ancient Wonders

The Pyramids of Egypt, built as tombs for Egyptian kings, are the oldest and best preserved of all the ancient wonders. The three largest pyramids, at Giza (Al Jizah), were the most famous. The Greeks and Romans marveled at the size of the pyramids, but they considered them foolish extravagances of the Egyptian kings. They made their lists about 2,000 years after the pyramids were built. By that time the religious importance of the pyramids as tombs had been forgotten. See PYRAMIDS.

The Hanging Gardens of Babylon were probably built for one of his wives by King Nebuchadnezzar II. He ruled Babylon from 605 to 562 B.C. Babylon was located near modern Baghdad in Iraq. No positive trace of the gardens remains, but scholars know about them from an account by Berossus, a Babylonian priest of the 200's B.C. Berossus described gardens laid out on a brick terrace about 400 feet (120 meters) square and 75 feet (23 meters) above the ground. To irrigate the flowers and trees, slaves worked in shifts turning screws to lift water from the Euphrates River. The massive brick walls that encircled Babylon were also notable, because they were so long and thick. Two chariots could travel side by side on top of the walls.

The Temple of Artemis at Ephesus, built about 550 B.C., was one of the largest and most complicated temples built in ancient times. It stood in the Greek city of Ephesus, on the east coast of what is now Turkey. It was entirely marble, except for its tile-covered wooden roof. The temple was dedicated to the Greek goddess Artemis. It was designed by the architect Chersiphron and his son, Metagenes. Its foundation measured 377 by 180 feet (115 by 55 meters). It had 106 columns, about 40 feet (12 meters) high, in a double row around the *cella* (inner space). Wealthy King Croesus of Lydia donated some of the columns.

The temple burned down in 356 B.C., and another one like it was built on the same foundation. Goths burned down the second temple in A.D. 262. Only the foundation and parts of the second temple remain.

The Statue of Zeus at Olympia, Greece, was perhaps the most famous statue in the ancient world. The sculptor Phidias made it about 435 B.C., and dedicated it to Zeus, the king of the gods. The statue, 40 feet (12 meters) high, showed Zeus on his throne. Zeus's robe and ornaments were made of gold, and his flesh of ivory. He had a wreath around his head and held a figure of Victory in his right hand and a *scepter* (king's rod) with an eagle in his left.

The Mausoleum at Halicarnassus, in what is now southwestern Turkey, was a huge marble building built as a tomb for Mausolus, an official of the Persian Empire. Its size and decorations made it so famous that all large tombs are now called *mausoleums*. The tomb was about 135 feet (41 meters) high. It had a rectangular basement beneath a colonnade formed by 36 columns. A stepped pyramid rested on the colonnade, and a statue of Mausolus in a chariot probably stood on top of the pyramid. The Greek architects Satyros and Pythios designed the tomb. Four famous sculptors—Bryaxis, Leochares, Scopas, and Timotheus—carved the *frieze* (decorated band) on the building. Only pieces of the building and its decorations remain.

The Colossus of Rhodes was a huge bronze statue that stood near the harbor of Rhodes on the Aegean Sea. The statue honored the sun god Helios. It stood about 120 feet (37 meters) tall—about as high as the Statue of Liberty. The sculptor Chares worked 12 years on it in the early 200's B.C. He used stone blocks and about $7\frac{1}{2}$ short tons (6.8 metric tons) of iron bars to support the hollow statue. In 224 B.C., soon after completion, the statue was destroyed by an earthquake. The metal was sold for scrap in A.D. 653.

The Lighthouse of Alexandria, about 440 feet (134 meters) high, stood on the island of Pharos in the harbor of Alexandria, Egypt. It became so famous that the word *pharos* came to mean *lighthouse*. The structure, designed about 270 B.C. by the Greek architect Sostratos, rose from a stone platform in three sections. The bottom section was square, the middle eight-sided, and the top circular. A fire on top provided light.

The Natural Wonders

World travelers and explorers list the following natural wonders: (1) Mount Everest, on the Nepal-Tibet border; (2) Victoria Falls on the Rhodesia-Zambia border; (3) Grand Canyon of the Colorado River; (4) Great Barrier Reef of Australia, the world's largest coral formation; (5) caves in France and Spain with their prehistoric paintings; (6) Parícutin, a young volcano in Mexico; and (7) the harbor at Rio de Janeiro.

Many other natural wonders are often listed, such as the giant sequoia trees of California; Rainbow Natural Bridge of Utah; Yellowstone Falls in Yellowstone National Park; Crater Lake and Wizard Island in Oregon; and the Carlsbad Caverns of New Mexico.

The Modern Wonders

World travelers and explorers list the following as modern wonders: (1) Suez Canal; (2) Dneproges Dam on the Dnepr River in Russia; (3) Atomic Energy Research Establishment at Harwell, England; (4) Alaska (or Alcan) Highway, connecting Alaska with Canadian and with other United States highways; (5) Golden Gate Bridge in San Francisco; (6) Eiffel Tower in Paris; and (7) Empire State Building in New York City.

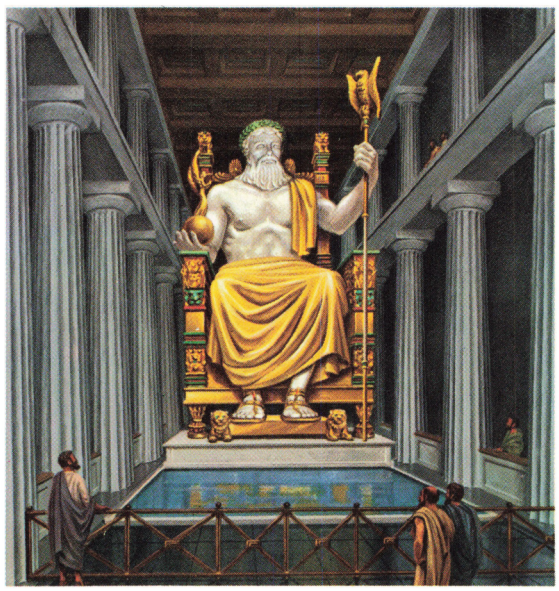
William P. Donovan, the contributor of this article, is Chairman of the Classics Department at Macalester College, St. Paul, Minn.

SEVEN WONDERS OF THE ANCIENT WORLD

Ancient Greeks and Romans made up many lists of outstanding man-made wonders. These illustrations show the objects that have been most commonly listed as the seven ancient wonders of the world. The map, *below right,* shows the location of the seven ancient wonders of the world in red.

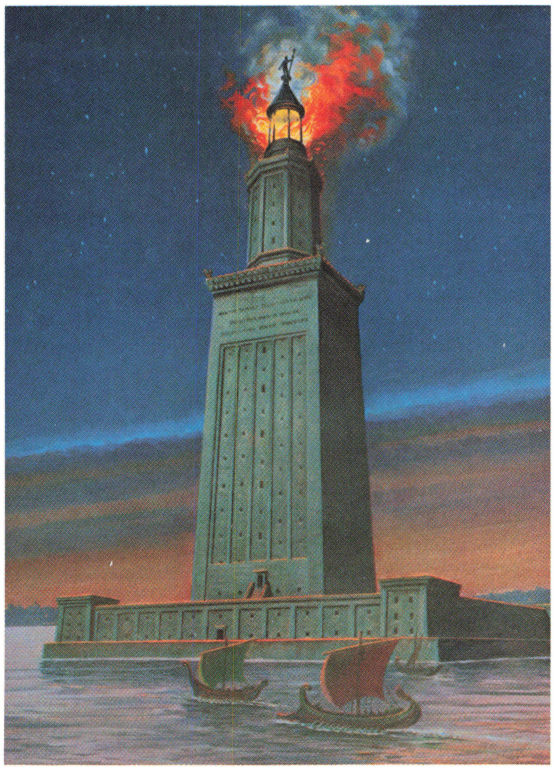
The Temple of Artemis at Ephesus was one of the largest temples built by the Greeks. It was famous for its decoration and extensive use of marble.

WORLD BOOK map FIa

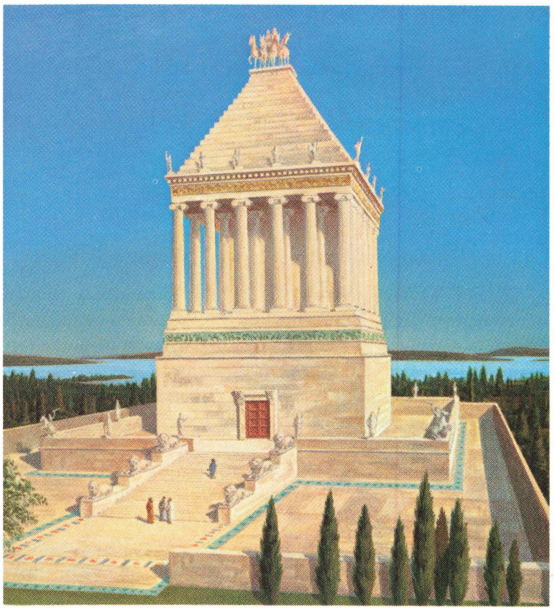


The Statue of Zeus at Olympia, Greece, was probably the most famous statue made by the Greeks. Thousands who came to Olympia for the Games admired this gold and ivory figure.

The Pyramids of Egypt are the only Seven Wonders of the Ancient World still standing. The largest Egyptian pyramids stand outside the present-day city of Cairo.



The Lighthouse of Alexandria, Egypt, was the world's first important lighthouse. It guided ships into the city's harbor for over 1,000 years before being toppled by an earthquake.



The Mausoleum at Halicarnassus was a great marble tomb. It was built for King Mausolus by some of the most famous Greek sculptors and architects living at that time.

The Hanging Gardens of Babylon probably were built by King Nebuchadnezzar after he married a mountain princess. He apparently hoped the gardens would make her feel at home.

WORLD BOOK illustrations by Birney Lettick

The Colossus of Rhodes was built in honor of the sun god Helios. It was constructed after the people of Rhodes survived a year-long siege by a large force of Macedonians.

Engineering groups sometimes list additional projects as wonders. WILLIAM P. DONOVAN

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Dneproges Dam	Mount Everest
Eiffel Tower	Parícutin
Empire State Building	Pyramids
Golden Gate Bridge	Suez Canal
Grand Canyon National Park	Victoria Falls

SEVEN YEARS' WAR (1756-1763) involved nearly every nation in Europe, and extended to America and India. In America, it was called the French and Indian War. While Prussia and Austria fought for control of Germany, Prussia's ally, England, and Austria's ally, France, battled for control of the seas and of the territories in North America. When it was over, Prussia had become the leader of the German states, and England had driven the French out of North America.

In Europe. The Seven Years' War began as a quarrel between Frederick the Great, King of Prussia, and Maria Theresa, Archduchess of Austria, over the possession of Silesia. Frederick had taken Silesia from Austria, but Maria Theresa never gave up hope of regaining her lost province. She allied herself with Czarina Elizabeth of Russia, who bitterly hated and feared the Prussian king. Maria Theresa found it more difficult to make an alliance with France, the ancient enemy of Austria. But she finally succeeded with the aid of her shrewd foreign minister Count Wenzel Anton von Kaunitz. He was aided by an agreement between England and Prussia. This agreement angered the French, who feared England, and it made them more sympathetic to Austria.

Meanwhile, Frederick the Great was carefully watching the moves of his enemies. He determined to strike the first blow. In August, 1756, he invaded Saxony, which had sided with Austria. The Austrians sent an army to defend Saxony, but the Prussians quickly defeated it. Frederick soon forced the entire Saxon army to surrender, and made himself master of the country.

In spite of these victories, Prussian hopes for victory were dim early in 1757. Sweden had joined Austria and its allies. Almost all of Europe was now united against the Prussian king. Britain was Prussia's only ally, and England gave but little help.

Frederick invaded Bohemia and won a battle near Prague. He then laid siege to Prague, but was defeated in the battle of Kolin. Frederick was outnumbered, but he moved with great vigor and decision. He attacked and defeated the French in a great battle at Rossbach, and then defeated the Austrians at Leuthen.

At the beginning of operations in the spring of 1758, Frederick's position was much improved. William Pitt came to power in Britain, and began to give more active aid to Prussia. The British organized a new army, which won several victories over Frederick's enemies. But Frederick's resources were limited, and Prussia had been weakened by his costly campaigns. Prussia was near exhaustion, and its ruin seemed almost certain.

Frederick reached his most desperate position in 1762. But in that year Elizabeth of Russia died suddenly and was succeeded by Peter III, an enthusiastic admirer of Frederick. He decided to take Russia out of the war, and began arrangements for a separate peace with Prussia. This turn of fate saved Frederick.

By terms of the peace signed in Hubertusburg early in 1763, Silesia remained under Prussian rule, and other boundaries remained as they had been before the war. There were no territorial changes in Europe. The Treaty of Paris settled disputes between France, Spain, and Great Britain on Feb. 10, 1763.

In America. One of the most important results of the Seven Years' War took place far from Europe. Britain finally won its long struggle with France for the control of North America. At the end of the Seven Years' War, France gave up Canada to Britain, and also gave up its empire in America. For a history of the war in America, see FRENCH AND INDIAN WARS. ROBERT G. L. WAITE

Related Articles in WORLD BOOK include:

Frederick (II) of Prussia	Pitt (family)
Maria Theresa	Pompadour, Marquise de
Paris, Treaties of	Silesia

SEVENTEEN-YEAR LOCUST. See CICADA.

SEVENTEENTH AMENDMENT. See CONSTITUTION OF THE UNITED STATES (Amendment 17).

SEVENTH-DAY ADVENTISTS are a Christian religious denomination. Members believe that Christ will return in person. They also observe the Sabbath on Saturday, the seventh day.

Adventists originated in the early 1800's, when many people in America and Europe became absorbed in the doctrine of Christ's second coming. References in the Bible that seemed to prophesy the time of Christ's coming aroused their interest. Followers of William Miller, a Baptist minister, predicted a definite time for the coming, but Miller's interpretation of what was to happen proved wrong. One group restudied Bible prophecies and decided that the beginning of the final judgment and Christ's coming were still in the future. This group organized in 1863 as the Seventh-day Adventists.

Adventist headquarters are at 6840 Eastern Avenue, Washington, D.C. 20012. For U.S. membership, see RELIGION (table).

Critically reviewed by the SEVENTH-DAY ADVENTISTS

SEVENTY YEARS' CAPTIVITY. See POPE (The Troubles of the Papacy).

SEVERN, RIVER, is one of Great Britain's chief waterways. It rises in Wales and takes a roundabout course through England for 210 miles (338 kilometers) to the Bristol Channel. A railroad from London to Wales uses a 4-mile (6.4-kilometer) tunnel under its mouth. Canals connect the Severn with the Trent, Thames, and Mersey rivers. Tidal waves often flood the banks of the Severn estuary. JOHN W. WEBB

SEVERSKY, ALEXANDER PROCOFIEFF DE. See DE SEVERSKY, ALEXANDER PROCOFIEFF.

SEVERUS, *see VEER us,* **LUCIUS SEPTIMIUS** (A.D. 146-211), a Roman emperor, reorganized the administration of the army and the provinces. He improved conditions for soldiers, and offered new career opportunities to provincial Romans. He also created a new treasury.

Severus was born in North Africa, in what is now Libya. He became an important government official. When the emperor Commodus died in 192, Severus joined a struggle for the throne during which the emperors Pertinax and Didius Julianus were assassinated. Severus seized control in 193. As emperor, he defeated two other claimants to the throne and defended Britain

against barbarians. An arch honoring his triumphs stands in the Roman Forum. RAMSAY MACMULLEN

SEVIER, *suh VEER,* **JOHN** (1745-1815), was an American soldier, frontiersman, and politician. He served as governor of "The lost state of Franklin," and later became the first governor of Tennessee.

Sevier, the son of a tavern keeper, was born near New Market, Va. He received little education, and as a young man supported himself by farming and trading. Sevier soon grew restless, and became a pioneer. In 1773, he moved to the Holston River Valley, then an unsettled region of the colony of North Carolina. It is now in eastern Tennessee. Here, Sevier soon became a leader.

Sevier actively supported the Revolutionary cause, but took little part in the fighting until 1780. In that year he led an expedition over the Smoky Mountains and helped defeat the British at Kings Mountain. Later he led an expedition against the Cherokee Indians. This was the first of many campaigns that brought him fame as an Indian fighter. After the Revolutionary War, the settlers in Tennessee began a movement to make the region a separate state. In 1784, the state of Franklin was organized and Sevier was elected governor the following year. Indian troubles, land speculation plots, and quarrels with rivals led to his downfall and the practical end of the state of Franklin in 1788. Sevier was later elected to the North Carolina Senate. From 1789 to 1791 he served in the federal Congress.

In 1796 "The lost state of Franklin" became part of the new state of Tennessee. Sevier was elected its first governor, and served a total of six terms. In 1796, he quarreled with Andrew Jackson, then one of his associates, over a land speculation Sevier had made. This quarrel embittered the rest of Sevier's life. After the end of his sixth term as governor, Sevier was elected to the state senate for one term and then served again in Congress until his death. A statue of Sevier represents Tennessee in the Statuary Hall collection in the U.S. Capitol in Washington, D.C. THOMAS D. CLARK

See also FRANKLIN, STATE OF.

SEVIER RIVER. See UTAH (Rivers and Lakes).

SEVILLE, *suh VIL,* or SEVILLA, *say VEEL yah* (pop. 548,072), is one of the leading centers of Spanish art, literature, and education. Two of Spain's greatest painters, Diego Velázquez and Bartolomé Murillo, were born in Seville. Two famous operas, *Carmen* and *The Barber of Seville,* have the city as their setting. Legend says that Don Juan lived in Seville. The legend of Don Juan furnished many writers and composers with material for their works. The University of Seville dates back to 1502.

The city lies 60 miles (97 kilometers) northeast of Cádiz on the Guadalquivir River, in an area of sunny vineyards and orange groves (see SPAIN [map]). A great wall with 64 towers once surrounded the city, and its remains still stand. The Moors lived in Seville for hundreds of years. Moorish influence shows in the city's network of small, shaded streets and in the whitewashed, balconied houses built around handsome courtyards and fountains. Fine squares with beautiful fountains lie throughout the city.

Seville's greatest building is its cathedral, started in 1402 and finished in 1519. It stands on the site of a Moorish mosque, and ranks next to St. Peter's in Rome as Europe's largest church structure. Some people think Christopher Columbus was buried in Seville's cathedral. But the Dominican Republic also claims to be the burial place of the famous explorer. Seville's emblem is the *Giralda,* a Moslem minaret that is part of the city's cathedral. The Giralda stands over 300 feet (91 meters) high. It was built in the 1300's.

Seville's factories produce cigars, pottery, silks, machinery, chocolate, perfume, and iron products. Canals and the Guadalquivir River make the city an important inland port. Exports include wine, olives and other fruit, and cork, mercury, and wool. The city is the capital of Seville province. STANLEY G. PAYNE

SÈVRES, *SEH vr',* **TREATY OF.** At the close of World War I, Turkey and the Allies signed the Treaty of Sèvres at Sèvres, France. The treaty was signed on August 10, 1920, and marked a low point in Turkish power and history. It provided that Syria, Palestine, and Mesopotamia (now Iraq) would be "provisionally recognized as independent states to be advised by mandatory powers."

Under the terms of the treaty, Turkey was to give up all its territorial claims in northern Africa, and to cede eastern Thrace to Greece. Smyrna (now Izmir) and the Ionian region were to be under Greek rule for five years. The independence of Armenia was recognized. The waters around Turkey were to be opened to the vessels of all nations, and the Turkish armed forces were to be reduced to a police force. The Treaty of Sèvres also provided for Turkish finances to be controlled by an Allied commission.

This treaty was signed by the Turkish government, but it was never ratified by the Turkish nationalists. The Turkish leader, Kemal Atatürk, overthrew the feeble Ottoman government and set up a new, independent Turkey. Ankara was made the new Turkish capital. Kemal Atatürk's government refused to recognize the treaty signed at Sèvres. Turkish forces defeated the Greeks at Afyonkarahisar and Bursa, and later drove the Greeks from Izmir. In 1923, the Turkish government negotiated a new peace treaty with the Allied Powers at Lausanne, Switzerland. DWIGHT E. LEE

See also IZMIR; ATATÜRK, KEMAL; LAUSANNE, TREATY OF.

SEWAGE is water that contains waste matter produced by man. It is also called *wastewater.* It contains about a tenth of 1 per cent solid matter. Sewage comes from the sinks and toilets of homes, restaurants, office buildings, and factories. It contains dissolved material that cannot be seen, plus bits of such solid matter as human waste and ground-up garbage. Most sewage also includes harmful chemicals and disease-producing bacteria.

Most sewage eventually flows into lakes, oceans, rivers, or streams. In the United States, almost all sewage is treated in some way before it goes into the waterways as a semiclear liquid called *effluent.* Untreated sewage looks and smells foul, and it kills fish and aquatic plants.

Even sewage that has been treated can harm the water in some ways. For example, most methods used to treat sewage convert organic wastes into inorganic compounds called *nitrates, phosphates,* and *sulfates.* Some of

these compounds may serve as food for *algae* and cause large growths of these simple aquatic plants. After the algae die, they decay. The decaying process uses up oxygen. If too much oxygen is used, fish and plants in the water will die.

A system of pipes that carries sewage from houses and other buildings is called a *sanitary sewerage system*. There are two main types of sanitary sewerage systems: (1) urban sewerage systems and (2) rural sewerage systems.

Urban Sewerage Systems

In most U.S. cities and towns, sewage from homes and other buildings flows into a public sewerage system. About 80 per cent of the nation's sewage comes from industrial sources. Many industries operate their own wastewater treatment facilities. Other industries partially treat the sewage and then discharge it into a public sewerage system. In some cases, industrial wastewater flows untreated into waterways.

In a public sewerage system, the largest sewers, called *interceptors*, carry the sewage to a *wastewater treatment plant*. Sewage treatment in most cities involves two main steps, *primary* and *secondary*. Some cities require an additional step called *tertiary* (third) treatment.

Primary Treatment removes the heaviest solid material from sewage. At a treatment plant, sewage first passes through a screen that traps the largest pieces of matter. It then flows through a *grit chamber*, where heavy inorganic matter, such as sand, settles. The liquid next flows into a large *primary sedimentation tank*. Many of the suspended solids sink to the bottom of this tank and form a muddy material called *sludge*. Grease floats to the surface, where it can be removed by a process called *skimming*. The effluent is then released into waterways.

Primary treatment removes about half the suspended solids and bacteria in sewage. Sometimes a gas called *chlorine* is added after primary or secondary treatment to kill most of the remaining bacteria. Primary treatment removes about 30 per cent of the organic wastes. When the remaining organic wastes are discharged into waterways, bacteria break them down and thus continue the process of purifying the wastewater. The breaking-down process uses up oxygen in the water. See WATER POLLUTION (Effects).

Secondary Treatment removes from 85 to 90 per cent of the solids and oxygen-consuming wastes remaining in sewage after it has undergone primary treatment. The most common methods of secondary treatment are (1) the activated sludge process and (2) the trickling filtration process.

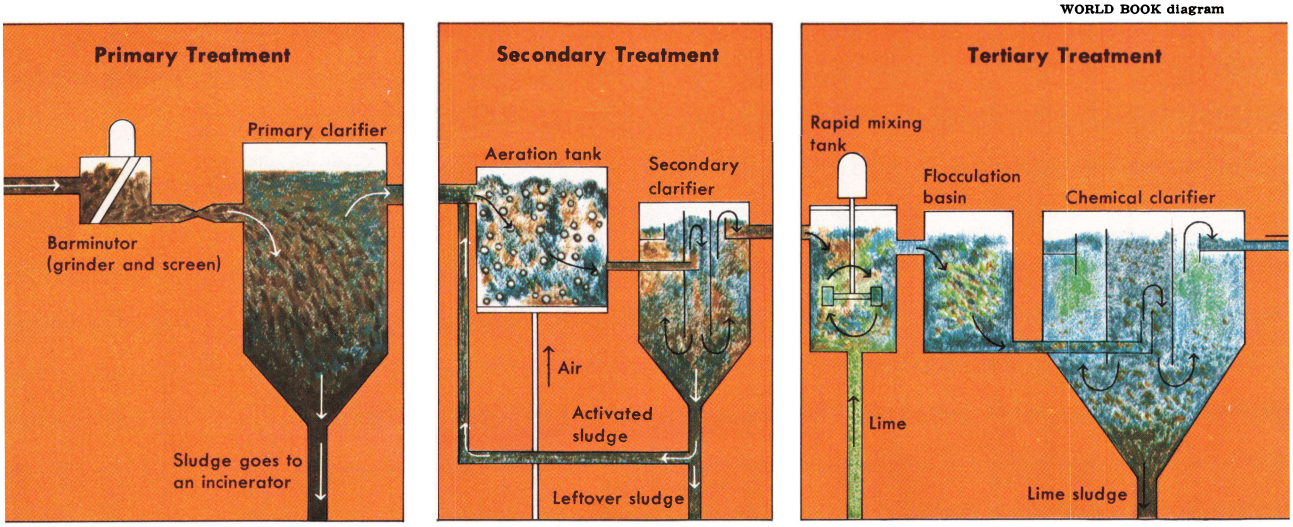
The Activated Sludge Process. In this process, effluent from the primary sedimentation tank flows into a second tank called an *aeration tank*. Air is injected into this tank in a bubbling action. Sludge containing useful bacteria is also in the tank. The useful bacteria move through the liquid and change the organic matter into less harmful substances. Next the liquid flows into a *final sedimentation tank*, where the sludge settles to the bottom. The effluent is then discharged into waterways. Part of the sludge is recycled back into the aeration tank.

The Trickling Filtration Process. Trickling filters are tanks filled with crushed rocks. As sewage is distributed over the rocks, it comes in contact with slime that develops on the rocks. The slime contains useful bacteria that change organic material in the sewage into less harmful substances. These substances are removed in a

A MODERN SEWAGE TREATMENT PLANT

The South Lake Tahoe, Calif., sewage treatment plant, diagramed below, provides primary, secondary, and tertiary treatment. During primary treatment, the largest solids in the sewage are ground up and then settle in a clarifier. Secondary treatment removes most of the organic matter through the activated sludge process. During tertiary treatment, the liquid is mixed with lime. The lime causes tiny particles of matter left in the liquid to floc (bunch together) and settle in a clarifier. The liquid then passes into a stripping tower, where nitrogen and ammonia are released. Finally, it is mixed with carbon, which removes the tiniest organic matter.

WORLD BOOK diagram



final sedimentation tank, where they settle to the bottom as sludge.

Sludge resulting from primary and secondary treatment is pumped to a *sludge digestion tank*. In this tank, bacteria break the sludge down into less harmful substances and, at the same time, produce methane gas, a useful fuel. The digested sludge may be dried for use as fertilizer or burned.

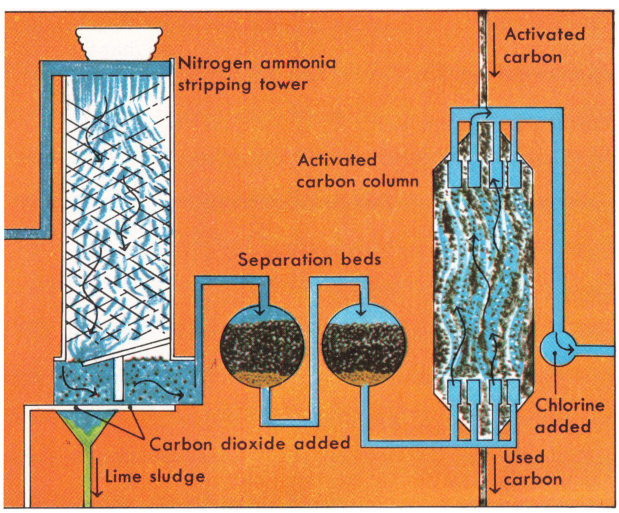
Tertiary Treatment is used after primary and secondary treatment to produce purer effluent. There are various methods of tertiary treatment. The method a community chooses depends on (1) what substances are present in its raw sewage and (2) how the effluent will be used. Tertiary treatment methods include chemical treatment, microscopic screening, radiation treatment, and discharging the effluent into lagoons.

Tertiary treatment makes effluent safer to discharge into waterways and safer for industry to use. Few treatment plants in the United States use all three methods of treatment—primary, secondary, and tertiary. However, many states are working with local communities to improve sewage treatment methods.

Rural Sewerage Systems

Many rural areas are not served by public sewers. In such areas, most homeowners use *septic tanks* to treat their sewage. These tanks are concrete or steel containers buried underground at individual homes and buildings.

Sewage flows into a septic tank through a pipe connecting the tank with a building. Solids in the sewage sink to the bottom of the tank as sludge or float to the surface as scum. Effluent then flows from the tank into a *leaching field*, a system of pipes with open joints that allows sewage effluent to be gradually distributed into the soil. Soil bacteria then destroy the remaining organic material in the effluent.



In a septic tank, bacteria in the sewage attack and digest the sludge and scum. This *digestion* process changes most of the wastes into gas and a harmless substance called *humus*. The gas escapes into the air. The humus in the tank must be pumped out periodically and taken to a sewage treatment plant. HARVEY WILKE

See also PLUMBING; WATER POLLUTION.

SEWALL, ARTHUR (1835-1900), was the Democratic candidate for Vice-President of the United States in 1896. He and William Jennings Bryan lost to Republicans William McKinley and Garret A. Hobart. Sewall was a Maine shipbuilder, banker, and railroad executive. He owned, built, and operated more sailing vessels than any other American between 1850 and 1900. Sewall was born in Bath, Me. IRVING G. WILLIAMS

SEWALL, SAMUEL (1652-1730), was a judge at the Salem (Mass.) witchcraft trials of 1692. Twenty persons were condemned to death and executed. Five years later, he publicly confessed that he had been wrong. Sewall considered himself more at fault than the other judges. In 1718, he was appointed chief justice of the superior court of judicature. He was born at Bishopstoke, England. DANIEL J. DYKSTRA

SEWARD, *SYOO urd*, **WILLIAM HENRY** (1801-1872), served as United States secretary of state during the Civil War. He was the leading Republican in the nation in 1860, but Abraham Lincoln defeated him for the party's nomination. Seward worked for Lincoln's election, and entered his Cabinet as secretary of state. Because of Seward's able administration of foreign affairs, European countries did not aid the Confederacy. He was wounded by an accomplice of John Wilkes Booth on the night that Lincoln was assassinated. He slowly recovered, and continued as secretary of state under President Andrew Johnson.

Among the important tasks that Seward accomplished was the purchase of Alaska from Russia. Alaska later proved valuable to the United States, and finally became a state in 1959. But at the time it was mockingly called "Seward's Folly" and "Seward's Ice Box." See ALASKA (American Purchase).

Seward was born in Florida, N.Y., and was educated at Union College in Schenectady, N.Y. He became a lawyer in 1822, and soon entered politics as a Whig (see WHIG). He served in the state legislature, and was governor of New York from 1839 to 1842. He became a United States senator in 1849. Seward was opposed to slavery, and fought against its spread. W. B. HESSELTINE

See also JOHNSON, ANDREW (Foreign Relations); LINCOLN, ABRAHAM (Election of 1860; Foreign Relations); TRENT AFFAIR; EMANCIPATION PROCLAMATION (picture).

SEWARD PENINSULA. See ALASKA (physical map).

SEWELL, *SOO el*, **ANNA** (1820-1878), wrote *Black Beauty* (1877), a story which was a protest against cruelty to horses. It became extremely popular. Anna Sewell was born in Yarmouth, England. A cripple, she could still ride her horse, and her love for it inspired the book. EVELYN RAY SICKELS

SEWELLEL. See MOUNTAIN BEAVER.

SEWER. See SEWAGE.

SEWING

SEWING is a useful occupation that many persons enjoy learning. They may make attractive and inexpensive clothing for themselves, or useful household articles. Beginners should choose designs that are easy to sew. In that way, they can devote all their attention to good design and attractive lines. They should first work with firm, soft materials, such as gingham or print, which are easy to sew.

Sewing Tools

Needles come in various sizes and kinds. Plain sewing is best done with *sharps*, which are needles of average length. Size 8 sharps are suitable with numbers 50 to 70 thread. Size 9 sharps are suitable with 80 to 100 thread.

Cotton Thread is of two general types. *Six-cord* thread comes in white and black. *Mercerized* thread comes in a range of colors. Six-cord thread is stronger than mercerized, because it has more strands and is twisted tighter.

The Thimble is a metal or plastic cap which fits over the end of the third finger of the sewing hand. It protects the finger and saves an extra motion in pushing the needle through the cloth.

Scissors should be of good steel with sharp cutting edges all the way to the points. Six-inch (15-centimeter) scissors or shears are suitable for cutting out garments. Shorter scissors are suitable for cutting threads, gashing, and trimming edges.

Pins should be of copper or steel, with sharp points. Dressmaker pins in size 5 are good.

Tape Measures should be of stitched double cloth with metal tips. They should be reversible, numbering 1 to 60 inches on one side, and 60 to 1 on the other. Metric tape measures number from 1 to 150 centimeters.

An Iron is used for pressing the work to prevent inaccurate stitching.

The Sewing Machine is the most used tool of all. The beginner should first practice on ruled paper without a thread. The sewer should learn to stitch on the lines by watching the position of the front of the presser foot. See SEWING MACHINE.

Basic Stitches

The Basting Stitch is a temporary stitch which is used to hold two pieces of material together and to guide the permanent sewing. In *even basting*, the stitches and spaces are of the same length. In *uneven basting*, the stitches and spaces are uneven. The pieces of cloth should be pinned together before they are basted.

The Running Stitch is a small regular stitch made by passing the needle over and under an equal amount of material. The cloth should be held straight and taut with the thumb and forefinger of the left hand, about 1 inch (2.5 centimeters) from the point of the needle. The needle should be woven through the cloth. When the needle is full, the cloth should be pulled off it.

When the running stitch is used for gathering, only one end of the thread should be fastened. A long tail of thread should be left at the other end until the material is pulled up. It is best to make two rows of gathering about $\frac{1}{4}$ inch (6 millimeters) apart.

The Plain Hemming Stitch is a slanting stitch used to hold a folded edge down to the material. It is made by placing the needle through the material and the folded edge of the hem. The needle should be slanted slightly, and the stitches kept small and at uniform distances. Starting without a knot, tuck the end of the thread under the fold of the hem. Hold the hem over the forefinger of the left hand. Finish with three little stitches in the fold. Then stitch the needle back through the fold so that the end of the thread is concealed.

Slip-Stitch Hemming is used on the bottom of skirts, where stitches should not be seen and the hem should be smooth. Take a very small stitch in the garment parallel with the hem. Slip the needle through the fold of the hem about $\frac{1}{4}$ inch (6 millimeters) from this stitch. Then repeat the operation.

The Overhand Stitch is a straight stitch used to join edges, hem napkins, or sew lace on a finished edge. Start without a knot, working over the end of the thread. Insert the needle at right angles to the edge of the material. Do not take too deep a stitch; otherwise a ridge will be formed. Fasten by sewing back over the stitches.

The Overcasting Stitch is a loose stitch made over raw edges to prevent raveling.

Simple Construction Processes

Seams are used to join two parts of a garment. The *plain seam* is made by placing the right sides of the cloth together, pinning, basting, and then stitching on the seam line. There are several ways to prevent the material in the seams from raveling. Firm material may be trimmed evenly or pinked with pinking shears, and pressed open. Edges which ravel may be pressed open and "self-stitched." Each edge is either turned down by hand or stitched by machine. Another method is to overcast the two edges together. Another is to press both edges to one side and stitch by machine on the right side. This is somewhat like the *flat-felled* and *lapped* seams.

The *lapped seam* is a tailored seam. The seam allowance of the top piece of material is pressed to the wrong side and basted to the seam line of the adjoining piece. It is then machine-stitched. This seam is also used when a ruffle or piping is put into the seam. The folded edge is basted to the ruffle or piping and basted a second time to the adjoining piece. Then it is stitched.

Flat-felled seams and *French seams* require more skill to make. They have no raw edges showing.

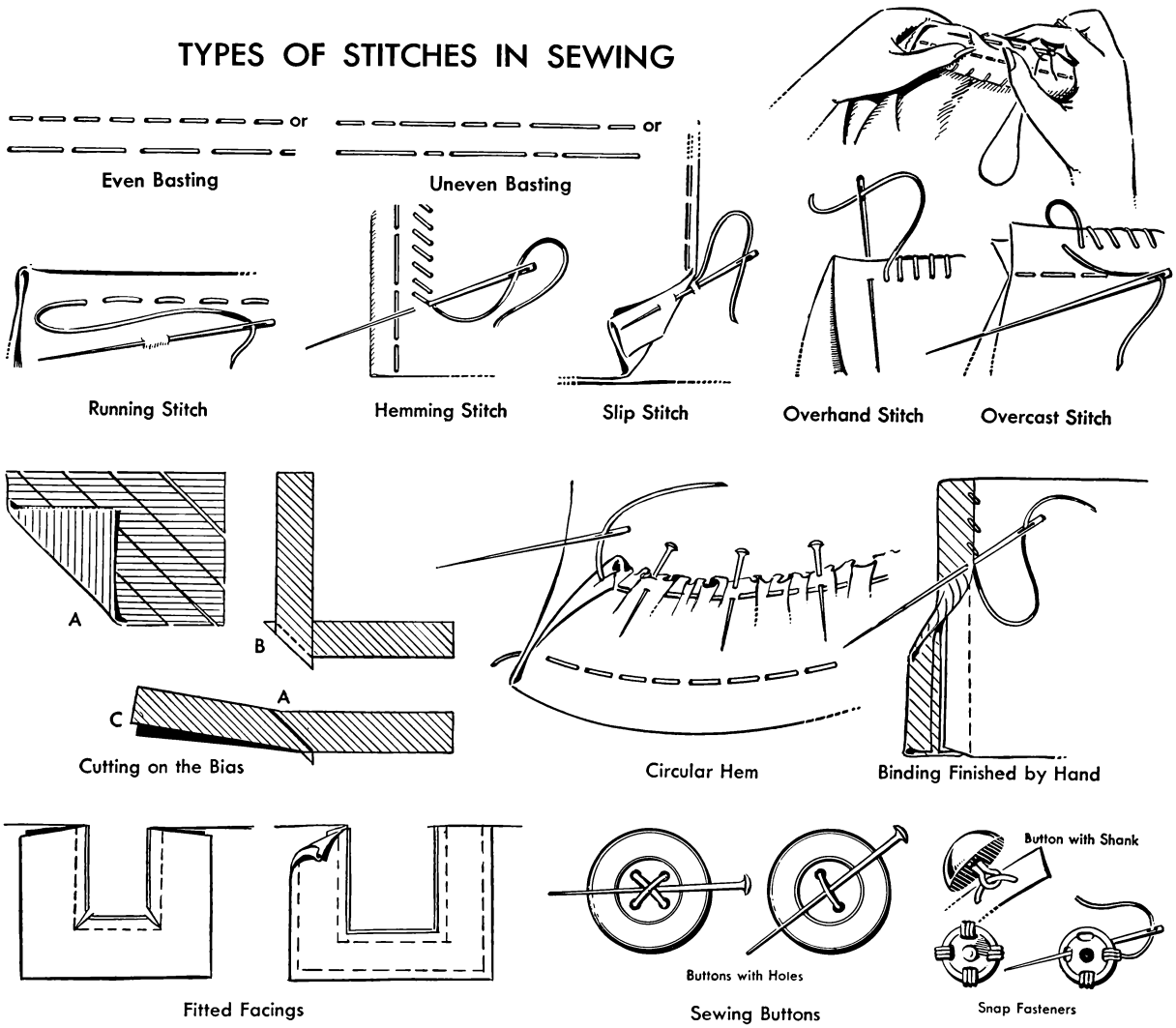
Bias is a line which cuts diagonally across the cloth. Ordinary cuts are made along the line of the thread. To obtain a true bias in cutting, fold the cloth so that the lengthwise threads of the cloth lie parallel with the crosswise threads. Press the fold. Open it out and mark off the number and width of bias strips needed. Cut the ends of the strips along the lengthwise threads of the material and piece together as shown in the illustration.

Edge Finishes give a finished appearance to an edge. Common types are hems, facings, bindings, and bands.

The *hem* is made by turning the raw edge of the article down about $\frac{1}{4}$ inch (6 millimeters) on the wrong side, then turning it down again the width desired. Curved hems should not be made too wide. The first fold should be gathered to distribute the extra fullness.

A *facing* is a separate piece of material sewed to lie flat on either the right or wrong side of the garment. Narrow facings are usually cut bias and placed on the wrong side. Fitted facings are cut to fit the garment in shape and match the weave or grain of the cloth.

A *binding* is a narrow-edged finish which always



shows. The edge to be bound should be cut without a seam allowance. Strips of bias material are then stitched on the right side of the garment. The binding is pressed against the seam and folded around it. The wrong side can be finished by hand or machine.

Bands are used at the waistline or bottom of the sleeve as belts and cuffs to hold in fullness. They are really wide bindings, cut on the lengthwise threads of the material rather than on the bias.

Plackets are finished openings in a garment to make it possible to slip the garment over wider parts of the body. Plackets at necklines are usually faced. Plackets in gathered skirts are usually hemmed. Those in fitted skirts or underarm seams are tailored and finished.

Fastenings

Buttons may be used as either decorations or fastenings. Their position on the cloth should be marked carefully. Starting with a knot and double thread, take a small stitch on the right side of the material so the knot will be under the button. Place a pin across the top of buttons with holes or under buttons with shanks and sew over the pin three to five times. Remove the pin. Bring the thread up under the button and wrap it around the threads so there is a strong thread shank. Then fasten the thread on the wrong side of the material.

Snaps should also be carefully placed. First sew the ball half of the snap on the front side of the placket. Then rub the ball with chalk and press it into the back side. This will mark the position for the socket half.

Other Fastenings include hooks and eyes, and "zippers," or slide fasteners. They must be sewed onto the clothing. Many dresses, particularly house dresses, are fastened only by belts or ties. JOSEPHINE F. EDDY

Related Articles in WORLD BOOK include:

SEWING AND NEEDLEWORK

Appliqué
Button
Clothing
Crochet
Dressmaking
Embroidery
Knitting
Needle Point
Petit Point
Quilt
Sampler
Singer, Isaac Merrit
Zipper

SEWING TOOLS

Needle Scissors Sewing Machine Thread

SEWING MACHINE

SEWING MACHINE is a machine that uses a needle to bind materials together with thread. It has lightened the household work of women and helped families to have better and less expensive clothing than they might otherwise have had. In factories, it has helped make possible the mass production of clothing.

Kinds of Sewing Machines. There are three main types of sewing machines for the home. They have different types of machine heads for sewing: the straight-needle, the swing-needle, and the slant-needle. All three kinds are made in both cabinet and portable models.

Straight-needle sewing machines are designed to make sewing as quick and easy as possible for the home seamstress who sews constantly. These machines can be used to do many kinds of decorative stitching, without the use of any special attachment. Various attachments added to the machine assist in such sewing tasks as ruffling, cording, and binding.

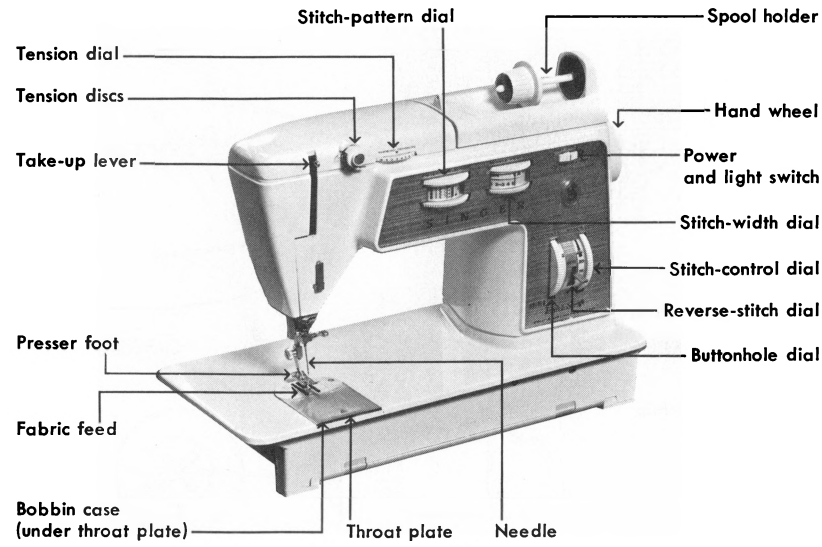
The *slant-needle sewing machine* resembles the straight-needle type, but has its needle slanted toward the user so she can see the work more easily.

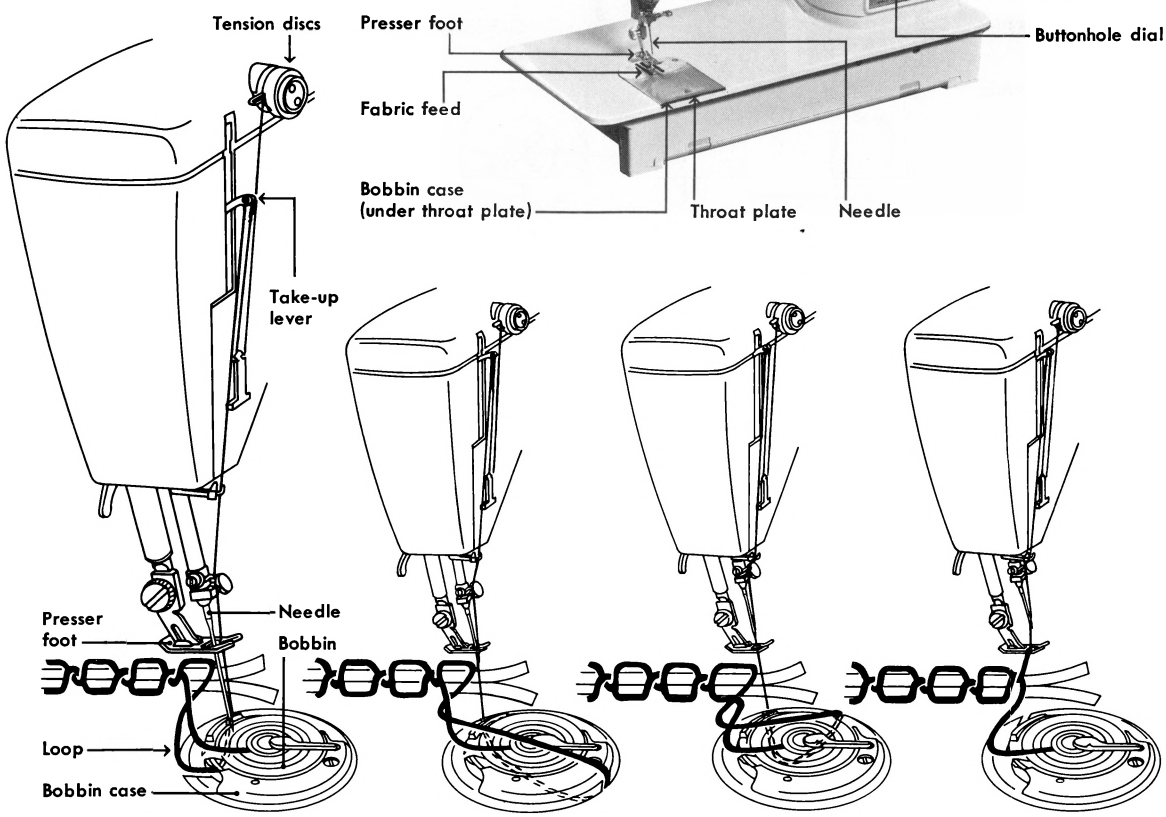
The *swing-needle sewing machine* is especially suited for use by women who do much decorative or hobby sewing. It does zigzag stitching, as well as many other kinds of decorative stitches, without special attachments. It can even be used to make wired flowers.

Many of the machines on which zigzag stitching can be done are manufactured in Europe. The Anker and

HOW A SEWING MACHINE WORKS

A modern sewing machine is driven by an electric motor and controlled with various dials. The machine shown at the right enables the sewer to control such details as the pattern and size of stitch. The machine makes a stitch in the steps described below.





1. A stitch is made with thread from the needle and from the bobbin. First, the needle and its thread enter the cloth.

2. As the needle rises, the needle thread forms a loop. The loop passes around the bobbin and encircles the bobbin thread.

3. The loop slips off the bobbin as the bobbin rotates. Then the needle rises and the stitch tightens around the cloth.

4. When the needle point is above the cloth, the fabric feed pulls more cloth forward and another stitch begins.

the Pfaff come from Germany; the Necchi and the Borletti from Italy; and the Viking from Sweden. These machines cost more than straight-needle machines.

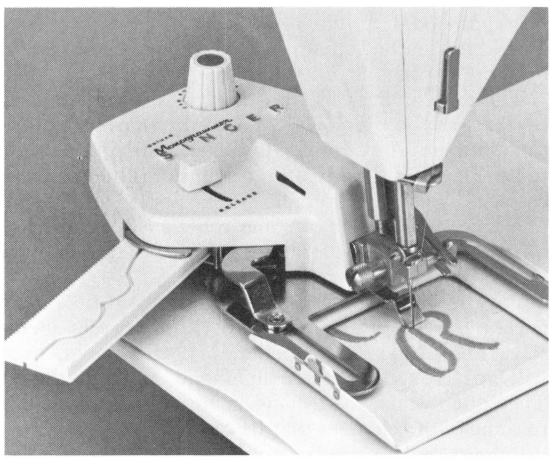
History. Thomas Saint, an Englishman, patented the first sewing machine in 1790. It was wooden, and made a single-thread chain stitch to stitch leather. The machine fed the thread automatically to a needle which had a notch instead of an eye. An awl made holes for the needle to pass through the leather. This machine was not practical. In 1830, Barthélemy Thimonnier (1793-1859) of France patented a machine for making soldiers' uniforms. His machine used a hooked needle that made a stitch by passing backward and forward through the cloth. The French government had as many as 80 of these machines in use at one time. Thimonnier was almost killed when a mob of angry workmen wrecked his machines because they put many men out of work. An American, Walter Hunt, invented a type of sewing machine in the 1830's, but never patented it.

Elias Howe is usually considered the inventor of the sewing machine as we know it today. His model, patented in 1846, was the first practical machine sold to users. Howe's machine had a needle with an eye near the point. A shuttle carried a thread below the cloth on a small bobbin. The needle, carrying an upper thread, was fastened to an arm that vibrated on a pivot. Movement of the arm forced the needle through the cloth. The shuttle carried the under thread through the loop of the upper thread, thus making a lock stitch. Nearly all sewing machines used in the home today are of this double-thread, lock-stitch type. A few women prefer the single-thread, chain stitch machine, such as the Willcox and Gibbs. The lock stitch is much like weaving in formation. It is less likely to ravel than the chain stitch, which is somewhat like the stitch used in crocheting. Of the inventors who came after Howe, A. B. Wilson and Isaac Singer deserve special mention. Wilson introduced the four-motion automatic feed used on nearly all present-day machines. It was patented in 1854. In 1851, Singer had patented the foot-operated treadle and the presser foot with a yielding spring, which holds the fabric down on the feed plate.

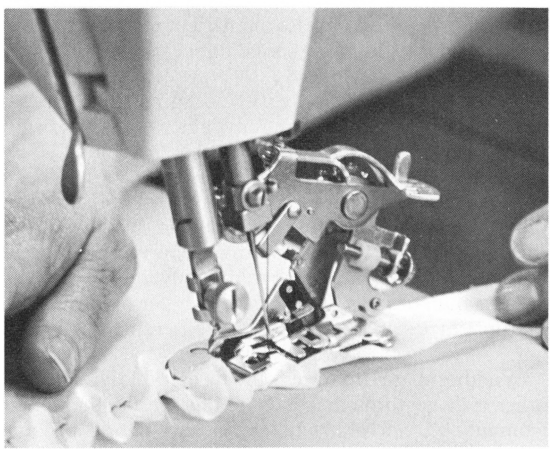
Today, there are special machines for sewing boots and shoes, books, umbrellas, and brooms. There is even a machine for sewing carpets together. This one travels along the carpet it stitches, because the carpet is too heavy to be moved easily. The Singer Sewing Machine Company first put an electric motor on a sewing machine in 1889. Today most sewing machines are electric, but some still have foot treadles.

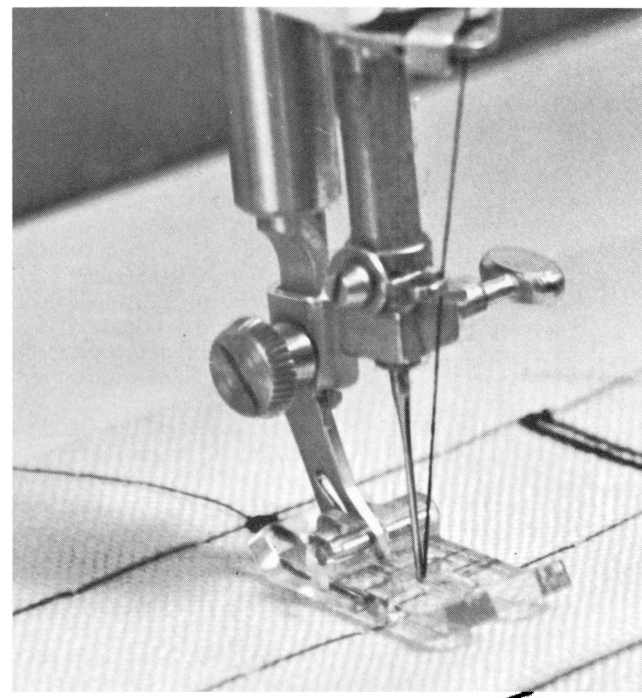
JOSEPHINE F. EDDY

See also HOWE, ELIAS; SINGER, ISAAC MERRIT; SEWING.



The Singer Co.





WORLD BOOK photos courtesy the Singer Company

Sewing Machine Attachments enable a sewer to add decorative and functional features to clothing. A monogrammer attachment, *above left,* makes letters of various sizes and designs. A ruffler attachment, *left,* gathers material. A special buttonhole presser foot, *above right,* guides the sewer in making basic buttonholes. Other attachments apply zippers, do fancy embroidery work, and simplify quilting. Many tasks, such as darning socks and sewing on buttons, can be done without special attachments.

SEX is what makes males and females different from each other. It also attracts them to each other and involves deep feelings and desires. Through sex, a man and a woman become interested in each other, fall in love, get married, and have children. Higher animals and plants produce their own kind, generation after generation, by means of sexual reproduction. But for humans, sex involves much more than reproduction. It has natural and important biological, psychological, and sociological effects on human lives.

Everyone is aware of sex because it influences everyone's personality and way of living. At the moment of birth, a baby is recognized as a boy or a girl. From that time on, he or she is raised somewhat differently as a member of his or her sex. Throughout their lives, males and females are expected to act in certain different ways.

Because sex involves much deeper personal feelings and desires than other areas of life, it is not discussed so openly as are other areas. As a result, many people are confused and bothered by their sexual feelings. Some view sex as something to laugh at, or to joke about. But throughout history, philosophers, scholars, and religious leaders have thought seriously about sex and its importance to individuals and to society. Most religions and cultures have developed moral standards concerning sex.

Today, sex is discussed more freely and publicly than ever before. Many schools and churches have begun sex education programs. These programs aim to help people of all ages understand sex and be at ease about their sexual feelings.

Because sex is such a powerful force, it is used in many ways to attract attention. Both males and females use various styles of clothing and grooming to make themselves attractive to one another. People who produce motion pictures, television programs, books, newspapers, and magazines know that "sex sells." Any movie, TV show, book, or article or story that deals with sexual interests is almost sure to be popular. Many advertisements on television and in newspapers and magazines use sexual appeals in order to attract attention to their products.

This article discusses sex as it is related to the lives of children, teen-agers, and adults. For a description of the methods by which man and various kinds of animals and plants reproduce, see the WORLD BOOK article on REPRODUCTION.

Males and Females

Babies are born male or female. As infants, they look and act much alike. They look alike because most of the physical differences between them do not develop until they reach their teens. They act alike because many of the different ways of behaving that are expected of them are learned throughout childhood.

The main physical difference between infant boys and girls is in the appearance of their *genitals* (sex organs). A boy has a *penis*, a finger-shaped organ between his legs. Behind the penis is a small sack called the *scrotum* that holds the *testicles*. Instead of a penis and a scrotum, a girl has small folds of flesh between her legs called the *vulva*. The vulva covers the opening to a narrow passage called the *vagina*, which leads to other female sex organs inside the body. In later years, after the sex organs have developed completely, they make it possible for a boy to become a father, and for a girl to become a mother.

Boys and Girls. As boys and girls grow, they remain similar in some ways, but become entirely different in many other ways. They each become more and more like other members of their own sex. Boys express their masculinity and girls express their femininity in the ways generally expected of them. They grow at different rates, develop different kinds of skills, and behave in different ways. Boys are generally thought of as stronger and rougher than girls. They are expected to play with such things as footballs and mechanical toys, and to become interested in the types of things men are interested in. Girls are thought of as having more tender feelings than boys. They are expected to play with dolls and to be interested in homemaking and other womanly activities.

Children learn some of the differences in behavior between the sexes from other boys and girls in their neighborhood or at school. But even before school age, a child has learned what it means to be male or female from living with his or her family.

The development of both boys and girls is affected by their relationships with the adults who are important to them. A boy tends to model himself after and to act like the most important man in his life. In most cases, this special man is his father, but it may be an uncle, a grandfather, or some other man. A girl frequently imitates her mother or some other woman who has an important place in raising her.

Boys and girls are naturally curious about the differences they see between one another, and between themselves and adults. They wonder about the changes they will go through between childhood and adulthood. They often watch the teen-agers around them for clues to some of the changes that lie ahead.

Puberty is the period of rapid growth that marks the end of childhood and the beginning of physical and sexual *maturity* (full development). During puberty, the bodies of boys and girls change noticeably, as do many of their feelings.

At the beginning of puberty, most girls are taller and grow faster than boys of the same age. After boys begin their period of rapid growth, they soon catch up. Many young people worry because some of their friends are growing and maturing more quickly than they are. But differences in the age at which puberty begins and in the rate of development during puberty are entirely normal. Some boys and girls mature several years earlier or later than others of their age. Each person grows and matures at the time and rate that is right for him or her.

Whether a girl matures slowly or rapidly, she and other girls go through the same changes as they enter womanhood. She grows taller, and her breasts become

Evelyn M. Duvall, the contributor of this article, is a family life consultant, and the author of About Sex and Growing Up *and* Love and the Facts of Life.

larger and round out. Her hips become wider, and hair grows under her arms and around her vulva. The widened hips will make it possible for her to give birth. The enlarged breasts will allow her to feed her babies milk from her own body.

One of the changes that takes place during a girl's growth to womanhood is the beginning of *menstruation*. Menstruation, a monthly discharge of blood and tissue from the vagina, is a normal part of a woman's life. Most girls start to menstruate when they are about 12 years old, but many begin at an earlier or later age than this. See MENSTRUATION.

As a boy goes through puberty, he becomes taller and heavier. His shoulders broaden, he gets stronger, and his voice becomes deeper. Hair grows on his face, under his arms, around his genitals, and on other parts of his body. Most boys consider the appearance of hair on the face one of the most important steps to manhood. They begin to shave, as they have seen their fathers and other men do for years.

When a boy nears sexual maturity, his sex organs become larger and he may experience *nocturnal emissions*, also called "wet dreams." Nocturnal emissions occur when a whitish fluid called *semen* is released through the penis while a boy or a man is sleeping. They are a natural way of releasing excess semen.

For both boys and girls, the development of the sex organs is accompanied by noticeable sexual feelings and tensions. Sometimes these tensions are relieved by *masturbating* (rubbing or handling the genitals). In the past, many people believed that masturbation caused various mental and physical problems, including insanity and pimples. These ideas have been proved false. But many people believe that masturbation can be morally wrong because it is a misuse of sexual powers. Masturbation becomes a problem when it causes people to feel anxious, guilty, or ashamed.

As boys and girls become aware of their developing masculinity and femininity, they may be disturbed about the changes they are experiencing. At the beginning of puberty, most young people associate mainly with members of their own sex, who are going through the same changes. As they become more mature and surer of themselves, they become increasingly interested in members of the opposite sex.

The teen years between puberty and adulthood are called *adolescence*. During adolescence, boys and girls gradually learn how to get along in more grown-up ways with people of both sexes and of all ages. They adjust to the bodily changes they experienced during puberty. They learn to become more independent and to make their own decisions. And they discover new ways of developing relationships with the other sex.

Boy-Girl Relationships. In the United States, boys and girls grow up together and become accustomed to one another long before they reach adolescence. Throughout childhood, they play together, go to school together, and take part in many of the same activities together. During the teen years, boy-girl relationships become much more important and more complicated. As teen-agers mature emotionally, sexually, and socially, they seek closer, more personal relationships with members of the opposite sex.

In the early teens, when boys and girls first begin to take a special interest in each other, they usually get together in groups. Common meeting places include schools and churches. Young people enjoy skating, swimming, club meetings, various projects, and other group activities. These group activities give boys and girls an opportunity to discover themselves in different situations and with a variety of persons of both sexes. Such social experiences help individuals become more sure of themselves, and prepare them for single dating, the next step in boy-girl relationships.

The age at which individuals start to date, like the time it takes them to mature, varies greatly. Many teens begin dating by going out with another couple or a group of couples. During the middle or late teens, most young people are ready to go out alone with their date.

Dating in American society involves many responsibilities and requires maturity on the part of both the boy and girl. Generally, but not always, the boy asks the girl for a date. He is usually expected to set the time and place for the date, assume responsibility for the girl, and pay the expenses. Both the boy and the girl are expected to dress appropriately, and to be courteous and pleasant. They also are expected to conduct themselves in ways expected by their families, their friends, and themselves.

As adolescents mature and become more at ease with one another, their emotional and physical attraction to members of the other sex increases. Both boys and girls want their appearance and actions to make them attractive to one another. They enjoy doing ordinary things together that bring them close to one another. A boy and girl get a sense of being desirable when they look into each other's eyes, laugh together, hold hands, and sit close to each other. Kissing has special importance because both boys and girls want more personal contact with one another.

Among dating couples, there comes a time when the boy, or the girl, or both, want closer physical contact than holding hands and kissing. The desire for more and more intimate physical contact is usually stronger in boys than in girls.

It is important that teen-agers understand and manage their sexual desires. When they do, they are likely to have enjoyable and rewarding relationships with members of the opposite sex. If they do not, they could become more physically and emotionally involved than they intend to or are ready to. Uncontrolled sexual desires can lead to *sexual intercourse*, the closest and most intimate form of physical contact. Sexual intercourse can start the process of reproduction. It could lead to an unmarried girl becoming pregnant. Most teen-agers, both boys and girls, are physically able to be parents. But few teen-agers are ready for the responsibilities of marriage or parenthood. Few unmarried young people plan to have babies. Those who do are usually carried away by their sexual feelings and by emotional desires they have not controlled. Sexual intercourse also involves important moral standards and deep personal feelings. It can cause serious moral, social, and psychological problems for young people.

The responsibility for controlling sexual desires belongs to both the boy and the girl. Because an ado-

lescent girl's sexual drives are not so urgent as a boy's, she is expected to set acceptable standards of behavior. A boy more easily recognizes his strong sex drive, and so it is his responsibility to control his actions.

Love. After two persons get to know each other well, they may feel they are in love. They begin to understand one another better than ever before. They enjoy being together as much as possible in many different situations and moods. They may come to care deeply for one another when each wants to cherish and protect the other. They enjoy doing things for one another, and find pleasure in sharing things and in discussing their feelings with each other.

There are many forms of love feelings. One of the questions a person must face is whether he or she is really in love at a particular time. For example, some persons mistake physical desire for love. But love based mainly on sexual attraction does not last long. A normal young person may fall in and out of love several times before establishing a lasting relationship.

Marriage and the Family

When a man and woman love one another, they usually want to get married and spend the rest of their lives together. But a successful marriage involves more than just being in love. Being married and raising children requires a couple to be mature enough to accept and enjoy new responsibilities. They must be ready to make many adjustments in their ways of living, and be financially able to support themselves.

A husband and wife express their love for each other in many ways. One of the most intimate ways is through sexual intercourse. Intercourse takes place when a man and woman lie close together and the man's penis is placed in the woman's vagina. This is usually psychologically and physically very pleasurable for both persons.

During intercourse, semen is released from the penis into the vagina. The semen contains millions of tiny male sex cells called *sperm*. Sometimes, but not always, a sperm *fertilizes* (unites with) a female sex cell called an *egg*. If this happens, a baby starts to develop inside the female and is born about nine months later. Many couples want to prevent some pregnancies in order to regulate the birth of their children. They plan their family by using some method of *birth control* (see BIRTH CONTROL).

With the birth of children, a couple's life changes greatly. A baby is helpless and depends on its parents for the love and care it needs. The child is best assured of healthy, happy development if the father and mother love each other and want to have a baby. So it is especially important that love, sex, and family living go together.

Sexual intercourse between two persons who are not married to each other is considered morally wrong by many religious groups and by many people. Sexual relationships outside marriage can result in feelings of guilt and other psychological problems for the persons involved. They can also result in the birth of an unwanted child.

Sex, when properly controlled, brings great satisfaction to human beings. But this powerful force must be controlled to assure fulfillment not only of the individual, but of society itself. EVELYN M. DUVALL

See also HOMOSEXUALITY; REPRODUCTION; TEEN AGE; VENEREAL DISEASE.

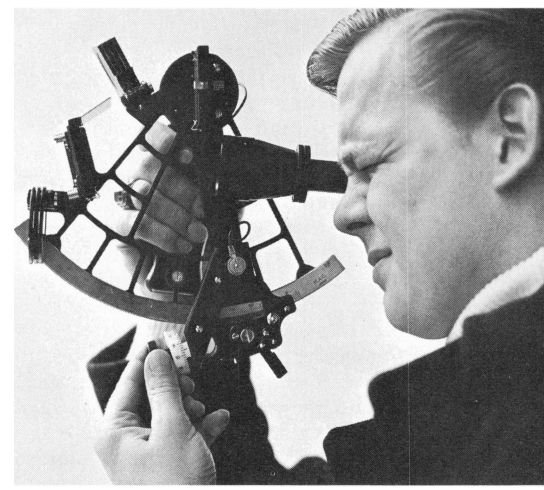
SEX RATIO is the proportion between the number of boys and girls that are born. Science has not yet been able to explain why there are 103 to 107 boys born to every 100 girls born. Thousands of birth records have been studied, of both man and animals. These studies reveal that many of the higher animals have slightly more of one sex than the other. Among horses, about 98 male colts are born to every 100 females. Sheep have the same sex ratio. Chickens have about 95 males to every 100 females. G. W. BEADLE

SEXTANT is an instrument that measures the angular distance between any two points, such as the sun and the horizon. Navigators use it to determine the position of their ships or aircraft.

The frame of a sextant supports the graduated arc of a sixth part of a circle, a movable arm which represents the radius of the circle, two mirrors, and a small telescope. One mirror is fixed and is known as the *horizon glass*. The second mirror is screwed to the movable arm, or index bar, and is called the *index glass*. The telescope sharpens the line of the horizon.

The sextant is held so that the arc is vertical and the horizon shows in the horizon glass. The operator looks through the telescope at the horizon glass. Then he moves the index arm until the image of the sun or a certain star, reflected in the index glass, touches the horizon line. The altitude of sun or star may be read from the graduated arc. The sailor then compares this altitude at various degrees of latitude. Thus he finds the latitude of his ship.

The sextant uses the optical rule: If an object is seen by repeated reflection from two mirrors perpendicular to the same plane, the angular distance of the object from its image is double the inclination, or tilt, of the mirrors. The sextant's index measures the angle between the mirrors. This is half the angular distance between the mirrors. Thus, half degrees read as full degrees.



WORLD BOOK photo

A Navigator Uses a Sextant to measure the angle between a star and the horizon. He must know this angle to find his position at sea by celestial navigation.

The *radio sextant* is a device that uses sensitive receiving equipment to locate the sun. It receives constant radio waves from the sun, and automatically tracks the sun in all weather conditions during daylight hours.

The *mirror sextant* was invented independently in 1730 by John Hadley in England and Thomas Godfrey in America. JOHN J. FLOHERTY

See also NAVIGATION.

SEXTILLION, *sehks TIHL yuhn*, in Canada, France, and the United States, is a number followed by 21 zeros. One sextillion is written 1,000,000,000,000,000,000,000. In England and Germany, sextillion is a number followed by 36 zeros.

SEXTON BEETLE. See BURYING BEETLE.

SEYCHELLES, *say SHEHL* (pop. 56,000), is a British dependency of 92 islands covering 145 square miles (376 square kilometers). They lie in the Indian Ocean, 700 miles (1,127 kilometers) northeast of Madagascar. The capital, Victoria, is on Mahé Island. The people speak French or a Creole dialect. Coconuts, cinnamon, patchouli, and vanilla grow in the volcanic soil. A governor and executive and legislative councils form the government. The governor is also commissioner of the British Indian Ocean Territory, which was created in 1965. The French held the Seychelles from the mid-1700's until the British took them in 1794. ROBERT I. CRANE

SEYMOUR, HORATIO (1810-1886), an American statesman, was a leading *Peace Democrat*, or *Copperhead*, during the Civil War (see COPPERHEAD). He was six times nominated for the governorship of New York, and was elected twice, in 1852 and in 1862. As governor during the war, he opposed President Lincoln's emancipation policy and the conscription law. He had many disputes with Lincoln over raising troops in New York. He was blamed for the 1863 draft riot in New York City, though he acted promptly to stop it.

He ran for the presidency in 1868 on the Democratic ticket, but was defeated by Ulysses S. Grant. Seymour was born in Onondaga County, New York. He practiced law for many years in Utica, N.Y. RICHARD N. CURRENT

SEYMOUR, JANE. See HENRY (VIII) of England.

SEYSS-INQUART, *ZYS IHNG kvahrt*, **ARTHUR VON** (1892-1946), was the leading Austrian Nazi. As the Austrian chancellor's adviser in the 1930's, he betrayed his country and helped Adolf Hitler seize Austria.

When Austria became German territory in 1938, Seyss-Inquart became its governor. He held a similar post in The Netherlands during World War II. After the war, he was tried and hanged in Nuremberg for his repressive policies. He was born in Stannern, in the German fringe of Bohemia. LESTER B. MASON

SFAX, *sfahks* (pop. 79,595), is the second largest city in Tunisia. For location, see TUNISIA (map). It is an important seaport. Its exports include phosphate, olive oil, sponges, almonds, and dates.

SFORZANDO. See MUSIC (Terms).

'S GRAVENHAGE. See HAGUE, THE.

SHABUOT, *shah VOO oht*, or FEAST OF WEEKS, is a Jewish festival that celebrates the day the Ten Commandments were revealed to Moses on Mount Sinai. It falls on the 6th day of the Hebrew month of Sivan. Orthodox and Conservative Jews outside of Israel observe it for two days. The holiday is called *Feast of Weeks* because it comes seven weeks, or "a week of weeks," after the first day of Passover (see PASSOVER).

The ancient Hebrews celebrated Shabuot as a harvest festival. They made pilgrimages to Jerusalem to offer sacrifices at the Temple. During the festival today, Jews read the scroll of Ruth, which describes harvesting in ancient Israel. According to one tradition, the scroll is read because King David, who was a descendant of Ruth, died on Shabuot. LEONARD C. MISHKIN

SHACKAMAXON, TREATY OF. See PENNSYLVANIA (Colonial Days).

SHACKLETON, SIR ERNEST HENRY (1874-1922), an Irish explorer, led a British expedition that came within 97 miles (156 kilometers) of the true South Pole in 1908 (see ANTARCTICA [Exploration]). In 1914, he led an expedition into the Weddell Sea, where ice crushed his ship. His party escaped in boats to Elephant Island. He went on to South Georgia Island and crossed its summit to alert rescuers. He wrote *Heart of the Antarctic* (1909) and *South* (1919). He was born in Kilkee, Ireland. JOHN EDWARDS CASWELL

United Press Int.
Sir Ernest Shackleton

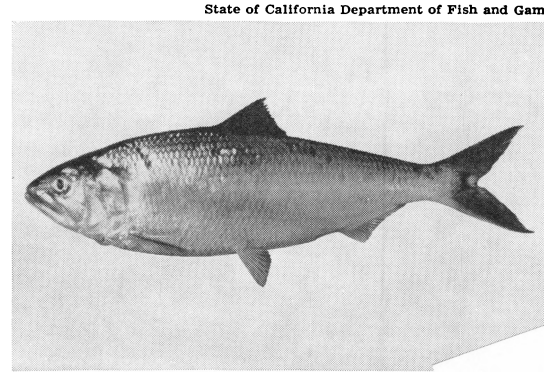
SHAD is an important food fish of the herring family. The American shad lives in the sea from Newfoundland to Florida. The former U.S. Bureau of Fisheries introduced it into the Pacific. The shad goes up fresh-water rivers to spawn. At that time, fishermen catch large numbers of shad in nets. Shad average about 3 pounds (1.4 kilograms) and are about 2 feet (61 centimeters) long. They are bluish above and have silvery sides.

Shad fisheries, which operate only at spawning time, have been greatly overworked, especially those of the East Coast rivers. So-called "Potomac shad" is shipped from the Pacific Coast to eastern markets. Most shad are eaten fresh, but a few are smoked or salted. Their eggs provide the best substitute for the *roe* (eggs) of sturgeon used in making caviar.

Scientific Classification. The common shad belongs to the herring family, *Clupeidae*. It is genus *Alosa*, species *A. sapidissima*. LEONARD P. SCHULTZ

See also HERRING.

The Shad Is Prized for Its Flesh and Roe (Eggs).
State of California Department of Fish and Game



SHAD FLY. See MAYFLY.

SHADDOCK. See GRAPEFRUIT.

SHADE. See COLOR (The Color Triangle).

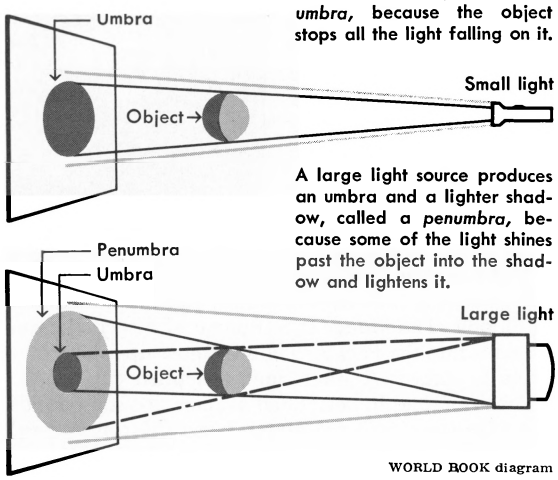
SHADOOF. See EGYPT (Agriculture).

SHADOW is the darkness that is cast when light shines on an *opaque* (nontransparent) object. The shadow falls from the side opposite the light source.

Shadows are all around us, wherever there is a source of light. We see shadows of trees and buildings. Our bodies cast shadows. The light of the sun also causes the earth to throw a huge shadow into space. The moon is *eclipsed* (darkened) when it passes into this shadow.

The diagrams below show how shadows are formed.

TYPES OF SHADOWS



WORLD BOOK diagram

In the upper diagram, the source of light is small. The opaque object stops all the light rays. No light passes behind the object, and the space between it and the screen is completely dark. In the lower diagram, the source of light is large. The object does not block all the light rays. As a result, the shadow has two parts. The *umbra* is the totally dark area, and the *penumbra* is the partially lighted area outside the umbra.

Shadows on the earth are not completely black, as they are on the moon or in space. The atmosphere scatters some light, and this light lightens the shadows. When light comes evenly from many directions, as on a hazy day, shadows are not cast. EARLE B. BROWN

See also ECLIPSE; PENUMBRA; SUNDIAL.

SHADOW MOUNTAIN DAM is in north-central Colorado. It forms Shadow Mountain Lake, which connects with Grand Lake. It is part of the Colorado-Big Thompson Project, designed to furnish a supplementary water supply to 615,000 acres (248,900 hectares) of farmland. It also supplies electric power to cities and towns in Colorado, Nebraska, and Wyoming. This earth dam is 63 feet (19 meters) high and 3,077 feet (938 meters) long. The U.S. Bureau of Reclamation built it in 1946. See also DAM. T. W. MERMEL

SHADOW PLAY, or SHADOW PANTOMIME, is a kind of drama in which the figures of puppets or living actors are thrown in silhouette on a screen. The players or puppets stand behind the screen and a light throws their shadows on the screen. The play is usually acted out in *pantomime* (without words). See also PUPPET.

SHADWELL, THOMAS. See POET LAUREATE.

SHAFT MINE. See COAL (Mining Methods); IRON AND STEEL (How Iron Is Mined).

SHAFTER, WILLIAM RUFUS (1835-1906), an American soldier, served as commander of land operations in Cuba during the Spanish-American War. In a month's fighting his forces captured Santiago and the entire eastern section of the island.

Shafter was born near Galesburg, Mich. He served in the infantry during the Civil War, and remained in the Army. In 1895, he received a Medal of Honor for his gallant fighting at Fair Oaks, Va., in 1862. H. A. DEWEERD

SHAFTESBURY was the title of two distinguished English statesmen.

Anthony Ashley Cooper (1621-1683), EARL OF SHAFTESBURY, an English statesman, secured the passage of the Habeas Corpus Act in 1679. This act is one of the mainstays of English freedom (see HABEAS CORPUS).

Cooper was born in Wimborne in Dorsetshire. He studied at Oxford University and entered Parliament in 1640. He became prominent under Oliver Cromwell during the Civil War and the Commonwealth. After Cromwell's death, he helped plan the restoration of the monarchy (see ENGLAND [The Civil War; The Restoration]). His efforts won him a pardon for his previous actions, when King Charles II came to the throne. The king made him Baron Ashley, earl of Shaftesbury, and lord chancellor. He became a member of the Cabal, worked to establish the Whig party, and supported the Test Acts against the Roman Catholics (see CABAL; TEST ACT; WHIG). His support of the Test Acts cost him his office.

In 1679 he became president of the Privy Council and passed the Habeas Corpus Act. But he became involved in a plot against the king and was arrested. He escaped to The Netherlands, where he died on Jan. 21, 1683.

Anthony Ashley Cooper (1801-1885), EARL OF SHAFTESBURY, was an English statesman and philanthropist. He served in Parliament from 1826 to 1851. He led a movement to improve the treatment of the insane and the living conditions of the poor in England. He was born in London. WILLARD M. WALLACE

SHAGBARK. See HICKORY.

SHAGREEN. See SHARK.

SHAH is the title of the ruler of certain Middle Eastern countries, such as Iran. See IRAN (Government; History); SHAH JAHAN.

SHAH JAHAN, *SHAH juh HAHN* (1592-1666), was the fifth ruler of the Mogul Empire in India. He became ruler in 1627. During his reign, the Moguls reached their golden age, with vaults crammed with treasures and with architecture in magnificent style. Shah Jahan is best remembered for the perfectly proportioned Taj Mahal, an immense tomb of white marble built for his wife in Agra, India (see TAJ MAHAL). He also built a palace of unbelievable splendor in Delhi. These and other buildings still stand as examples of Mogul glory. The dynasty began its decline because too much money was spent on luxuries and too much effort was wasted in war. Shah Jahan's reign was a troubled one, and one of his sons took his throne by force. T. WALTER WALLBANK

Tempera painting on canvas (1931); collection of the Whitney Museum of American Art, New York City

Shahn's *The Passion of Sacco and Vanzetti* was one of a series of 23 pictures the artist painted to protest the execution in 1927 of two anarchists convicted of murder in Massachusetts.

SHAHN, BEN (1898-1969), an American painter, tried through his art to communicate with people and influence their thinking and emotions. His realistic paintings and drawings deal directly and powerfully with such themes as labor movements, race relations, and atomic warfare.

Shahn was born in Lithuania and came to the United States when he was 8. He first attracted attention in the 1930's with a series of paintings about the Sacco-Vanzetti trial. Shahn saw no difference between fine art and commercial art. He accepted many commissions in advertising and commercial art. His style has been influential in these fields, especially in book illustration. ALLEN S. WELLER

See also SACCO-VANZETTI CASE.

SHAKERS are members of the religious sect called the United Society of Believers. The sect was started in England about 1706, as an offshoot of the Quakers. In 1758, Ann Lee (1736-1784) joined the society, and in 1770 members recognized her as the leader of the Church of God on earth. Shakers called her *Mother Ann* and made her the head of the society.

In 1774, Mother Ann led a group of Shakers to America and organized a society at Watervliet, N.Y. This was the first communistic organization in the United States. All property belonged to the community as a whole.

Members of the society are called *Shakers* because during religious exercises their intense emotions cause them to quiver and shake. Shakers do not marry, and bear no children. The society now has fewer than 15 members, who live in two New England communities.

The Shakers have made many important contributions to American life. The Shakers were the first producers of commercial seed in the United States. They invented the circular saw, cut nails, a washing machine, flat brooms, and the first metal pen points. The fine furniture early Shaker communities produced is now prized as collectors' items. GEORGE R. MONELL

SHAKERTOWN. See KENTUCKY (Places to Visit; color picture: Shakertown near Lexington).

Historical Society of Pennsylvania

Colonial Shakers at Worship trembled and chanted wordless songs. A church leader said he saw the Hosts of Heaven worshiping in this manner, and he taught the movements to his people.

Stratford Festival Theatre, Ontario

Highly Dramatic Scenes add to the power of Shakespeare's great tragedies. In this scene from *Julius Caesar,* the young Roman leader Mark Antony delivers an eloquent funeral address over the body of the assassinated Roman ruler Julius Caesar. Antony begins his address to a crowd of common people with the famous line "Friends, Romans, countrymen, lend me your ears."

WILLIAM SHAKESPEARE

SHAKESPEARE, WILLIAM (1564-1616), was an English playwright and poet. He is generally considered the greatest dramatist the world has ever known and the finest poet who has written in the English language. Shakespeare has also been the world's most popular author. No other writer's plays have been produced so many times or read so widely in so many countries.

Many reasons can be given for Shakespeare's broad appeal. But his fame basically rests on his understanding of human nature. Shakespeare understood people as few other artists have. He could see in a specific dramatic situation the qualities that relate to all human beings. He could thus create characters that have meaning beyond the time and place of his plays. Yet his characters are not symbolic figures. They are remarkably individual human beings. They struggle just as people do in real life, sometimes successfully and sometimes with painful and tragic failure.

Shakespeare wrote at least 37 plays, which have traditionally been divided into comedies, histories, and tragedies. These plays contain vivid characters of all types and from many walks of life. Kings, pickpockets, drunkards, generals, hired killers, shepherds, and philosophers all mingle in Shakespeare's works.

In addition to his deep understanding of human nature, Shakespeare had knowledge in a wide variety of other subjects. These subjects include music, the law, seamanship, the Bible, military science, the stage, art, politics, history, hunting, woodcraft, and sports. Yet as far as scholars know, Shakespeare had no professional experience in any field except the theater.

Shakespeare was born to what today would be called middle-class parents. His birthplace was the small market town of Stratford-upon-Avon. Shortly after he married at the age of 18, Shakespeare apparently left Stratford to seek his fortune in the theatrical world of London. Within a few years, he had become one of the city's leading actors and playwrights. By 1612, when he seems to have partially retired to Stratford, Shakespeare had become England's most popular playwright.

Shakespeare has had enormous influence on culture throughout the world. His works have helped shape the

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literature of all English-speaking countries and of such countries as Germany and Russia. Shakespeare also contributed greatly to the development of the English language. He freely experimented with grammar and vocabulary and so helped prevent literary English from becoming fixed and artificial.

Shakespeare's influence on language has not been limited to writers and scholars. Many words and phrases from Shakespeare's plays and poems have become part of our everyday speech. They are used by millions of people who are unaware that Shakespeare created them. For example, Shakespeare originated such familiar phrases as *fair play*, *a foregone conclusion*, *catch cold*, and *disgraceful conduct*. As far as scholars can tell, Shakespeare also invented such common words as *assassination*, *bump*, *eventful*, and *lonely*.

Many people can identify lines and passages as Shakespeare's even though they have never seen or read one of his plays. Examples include "To be, or not to be," "Friends, Romans, countrymen, lend me your ears," and "A horse! a horse! my kingdom for a horse!"

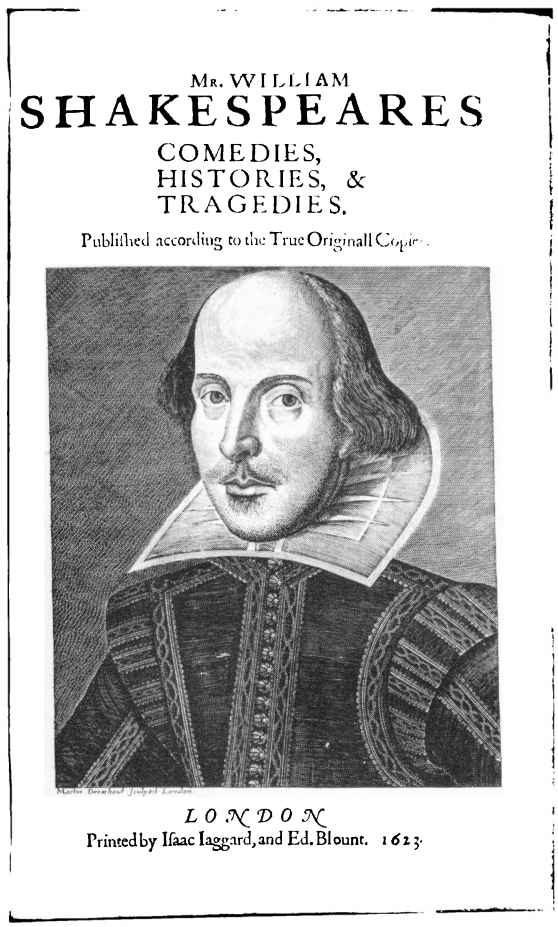
Shakespeare's genius as a poet enabled him to express an idea both briefly and colorfully. In his tragedy *Othello*, for example, he described jealousy as "the green-eyed monster which doth mock the meat it feeds on." In the tragedy *King Lear*, Shakespeare described a daughter's ingratitude toward her father as "sharper than a serpent's tooth."

Besides influencing language and literature, Shakespeare has affected other aspects of culture in the English-speaking world. His plays and poems have long been a required part of a liberal education. As a result, Shakespeare's ideas on such subjects as heroism, romantic love, and the nature of tragedy have helped shape the attitudes of millions of people. His brilliant portrayals of historical figures and events have also influenced our thinking. For example, many people visualize Julius Caesar, Mark Antony, and Cleopatra as Shakespeare portrayed them, not as they have been described in history books.

Even historians themselves have been influenced by Shakespeare's greatness. Shakespeare lived in England during the reign of Queen Elizabeth I, a period known as the *Elizabethan Age*. Historians consider the Elizabethan Age as a peak of English culture. But one can question whether the period would seem so important if Shakespeare had not lived and worked in it.

Shakespeare's widespread influence reflects his astonishing popularity. His plays have been a vital part of the theater in the Western world since they were written more than 300 years ago. Such works as *Hamlet*, *Romeo and Juliet*, *Macbeth*, *A Midsummer Night's Dream*, and *Richard III* rank among the most popular plays ever written. Through the years, most serious actors and actresses have considered the major roles of Shakespeare to be the supreme test of their art.

Shakespeare's plays have attracted large audiences in big, sophisticated cities and in small, rural towns. His works have been performed on the frontiers of Australia and New Zealand. They were part of the cultural life of the American Colonies and provided entertainment in the mining camps of the Old West. Today, there are theaters in England, the United States, and Canada dedicated to staging some of Shakespeare's works every year.

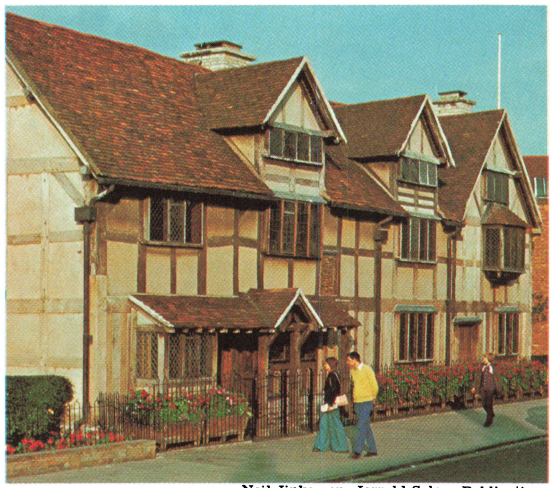


Engraving (1623); Folger Shakespeare Library, Washington, D.C.

A Portrait of Shakespeare appears in the First Folio, the first edition of Shakespeare's collected plays. This portrait by the English artist Martin Droeshout is one of two images of the playwright considered authentic. The other is shown on page 273.

Shakespeare's plays appeal to readers as well as to theatergoers. His plays—and his poems—have been reprinted and translated countless times. Indeed, a publishing industry flourishes around Shakespeare, as critics and scholars examine every aspect of the man, his writings, and his influence. Each year, hundreds of books and articles appear on Shakespearean subjects. Thousands of scholars from all over the world gather in dozens of meetings annually to discuss topics related to Shakespeare. Special libraries and library collections focus upon Shakespeare. Numerous motion pictures have been made of his plays. Composers have written operas, musical comedies, and instrumental works based on his stories and characters.

The world has admired and respected many great writers. But only Shakespeare has generated such varied and continuing interest—and such constant affection.



Neil Jinkerson, Jarrold Colour Publications

Shakespeare's Birthplace was probably one of these two adjoining houses in Stratford. According to tradition, the playwright was born in the house on the left, called the *Birthplace*.

Peter Baker

A Bedroom in the Birthplace is furnished in the style common among middle-class families of Shakespeare's day. Shakespeare may have been born in this room.

During the Elizabethan Age, the English cared little about keeping biographical information unrelated to affairs of the church or state. In addition, playwriting was not a highly regarded occupation, and so Elizabethans saw little point in recording the lives of mere dramatists. However, a number of records exist that deal with Shakespeare's life. They include church registers and accounts of business dealings. Although these records are few and incomplete by modern standards, they provide much information. By relating these records to various aspects of Elizabethan history and society, scholars have filled in the gaps in the factual account of Shakespeare's life. As a result, they have a reasonably clear and dependable biography of the playwright.

His Life in Stratford

Shakespeare's Parents. John Shakespeare, William's father, was a glove maker who owned a shop in the small market town of Stratford-upon-Avon. Stratford lies about 75 miles (120 kilometers) northwest of London in the county of Warwickshire. John Shakespeare was a respected man in the town and held several important positions in the local government.

William Shakespeare's mother was born Mary Arden. She was the daughter of a farmer but related to a family of considerable social standing in the county. John Shakespeare married Mary Arden about 1557. The Ardens were Roman Catholics. Mary may also have been a Catholic, but the Shakespeares publicly belonged to the Church of England, the state church.

Early Years. William Shakespeare was born in Stratford in 1564, the third of eight children. The register of Holy Trinity, the parish church in Stratford, records his baptism on April 26. According to the custom at that time, infants were baptized about three days after their birth. Therefore, the generally accepted date for Shakespeare's birth is April 23.

The Shakespeares were what today would be called a prominent middle-class family. In 1565, John Shakespeare became an alderman. Three years later, he was elected *bailiff* (mayor), the highest civic honor that a Stratford resident could receive. Later, he held several other civic posts. But toward the end of his life, John had financial problems.

Beginning at about the age of 7, young William Shakespeare probably attended the Stratford grammar school with other boys of his social class. The school's highly qualified teachers were graduates of Oxford University. Students spent about nine hours a day in school. They attended classes the year around, except for three brief holiday periods. The teachers enforced strict discipline and physically punished students who broke the

By permission of the Headmaster and Governors (Peter Baker)

The Stratford Grammar School provided Shakespeare with all his formal education. He probably entered the school at about the age of 7. The school dates from 1417 and is still used.

rules. The students chiefly studied Latin, the language of ancient Rome. Knowledge of Latin was necessary for a career in medicine, law, or the church. In addition, Latin was considered a sign of an educated person. Young Shakespeare may have read such outstanding ancient Roman authors as Cicero, Ovid, Plautus, Seneca, Terence, and Virgil.

By modern standards, the Stratford grammar school must have been demanding, dull, and strict. And no evidence exists that Shakespeare had any teacher who might have stirred his imagination and brought routine studies alive.

In spite of the long hours in school, Shakespeare's boyhood was probably not all boring study. As a market center, Stratford was a lively town. In addition, holidays provided popular pageants and shows, including plays about the legendary outlaw Robin Hood and his merry men. By 1569, traveling companies of professional actors were performing in Stratford. Stratford also held two large fairs each year, which attracted numerous visitors from other counties. For young Shakespeare, Stratford could thus have been an exciting place to live in.

Stratford also offered Shakespeare other pleasures. The fields and woods surrounding the town provided opportunities to hunt and trap small game. The River Avon, which ran through the town, had fish to catch. Shakespeare's poems and plays show a love of nature and rural life, undoubtedly reflecting his childhood experiences and love of the Stratford countryside.

Marriage. In November, 1582, Shakespeare received a license to marry Anne Hathaway. She was probably the daughter of a farmer who lived in Shottery, a village about 1 mile (1.6 kilometers) from Stratford. At the time of their marriage, Shakespeare was 18 years old and Anne was 26. Their first child, Susanna, was baptized on May 26, 1583.

The Lost Years. Early in 1585, Anne Shakespeare gave birth to twins—a boy, Hamnet, and a girl, Judith. No significant factual information exists on Shakespeare's life for the period between Feb. 2, 1585, when the twins were baptized, and 1592, when evidence indicates Shakespeare was living in London. Scholars sometimes call this period *the lost years*.

Shakespeare's name appears with his parents' names in a Stratford lawsuit in 1588. But he may not have been living in Stratford at that time. Scholars believe that sometime during the lost years Shakespeare moved to London and served a period of apprenticeship in the city's busy theatrical life.

Early Career in London

First Recognition. There is some indication that Shakespeare had become well known in London theatrical life by 1592. That year, a pamphlet appeared with an apparent reference to Shakespeare. This reference suggested he had become both an actor and a playwright. A writer named Robert Greene had written a letter attacking theater owners, actors, and writers who, he believed, had abused the talents of university-educated playwrights, such as himself. After his death, the letter was published in a pamphlet called *Greene's Groatsworth* [a few cents' worth] *of Wit Bought with a Million of Repentance*. Most scholars agree that in one passage Greene attacked Shakespeare as an actor who thought he could write plays as well as educated dramatists could. This passage follows, with the Elizabethan spelling and punctuation modernized:

> . . . an upstart Crow, beautified with our feathers, that with his *Tiger's heart wrapped in a Player's hide*, supposes he is as well able to bombast out a blank verse as the best of you: and being an absolute *Johannes fac totum* [Johnny-do-everything], is in his own conceit the only Shake-scene in a country.

The line "Tiger's heart wrapped in a Player's hide" pokes fun at a line spoken by the Duke of York in Shakespeare's *Henry VI*, Part III. The line is "O tiger's heart wrapped in a woman's hide."

Following the publication of *Greene's Groatsworth of Wit*, Shakespeare must have complained about the attack to Henry Chettle, Greene's editor. Chettle then published an apology in which he appeared to praise Shakespeare as a polite and honest man as well as a fine writer. Part of Chettle's apology follows, with the spelling modernized:

> . . . I am as sorry as if the original fault had been my fault because myself have seen his demeanor no less civil than he excellent in the quality [acting occupation] he professes: Besides, divers of worship [various people of good reputation] have reported his uprightness of dealing, which argues his honesty, and his facetious [polished] grace in writing, that approves his Art.

His Work in Theater Companies. Sometime after he arrived in London, Shakespeare probably joined one of the city's *repertory* theater companies. These companies consisted of a permanent cast of actors who presented a variety of plays week after week. The companies were commercial organizations that depended on admission prices for their income. They staged most of the plays Londoners attended.

Scholars do not know which theater company or companies Shakespeare joined before 1594. But he was a *sharer* (stockholder) of a company called the Lord Chamberlain's Men in 1594. The evidence consists of a record of payment to Shakespeare and his fellow actors for performances of the company at Queen Elizabeth's court. The Lord Chamberlain's Men was one of the most popular acting companies in London. Shakespeare was a leading member of the group for the rest of his career. By 1594, at least six of Shakespeare's plays had been produced.

His First Poems. From mid-1592 to 1594, London authorities often closed the public theaters because of repeated outbreaks of plague. The need for new plays thus declined. At this time, Shakespeare began to write poems. The Elizabethans considered the writing of poetry much more important than the writing of plays. Shakespeare perhaps believed that by writing poems he might be able to win the praise that mere playwriting never received.

In 1593, Shakespeare's long poem *Venus and Adonis* was printed by Richard Field, a Stratford neighbor who had become a London printer. Shakespeare dedicated

the poem to 19-year-old Henry Wriothesley, the Earl of Southampton. The poet may have believed that the dedication would win him the earl's favor and support. *Venus and Adonis* quickly became a success.

Field printed Shakespeare's next long poem, *The Rape of Lucrece*, in 1594. Shakespeare also dedicated this poem to the Earl of Southampton. The wording of the dedication suggests the possibility that the young nobleman had rewarded the author, probably financially, for his dedication in *Venus and Adonis*.

Both poems went through many editions during Shakespeare's lifetime. But their success did not lead Shakespeare to give up playwriting. After the public theaters were reopened in 1594, he began again to write plays. Indeed, Shakespeare was one of the few Elizabethan writers who concentrated almost solely on the theater as a career.

The Years of Fame

From 1594 to 1608, Shakespeare was fully involved in the London theater world. In addition to his duties as a stockholder and actor in the Lord Chamberlain's Men, he wrote an average of almost two plays a year for his company. During much of this period, Shakespeare ranked as London's most popular playwright, based on the number of times his plays were performed and published. But his reputation was largely that of a popular playwright, not of a writer of unequaled genius. Few people gave him the praise that later generations heaped on him. An exception was the English clergyman and schoolmaster Francis Meres.

In 1598, Meres wrote *Palladis Tamia: Wit's Treasury*, a book that has become an important source of information about Shakespeare's career. In this book, Meres said of Shakespeare: "As *Plautus* and *Seneca* are accounted the best for Comedy and Tragedy among the Latins: so *Shakespeare* among the English is the most excellent in both kinds for the stage." Although Meres' praise did not represent everyone's opinion, it indicates that Shakespeare had become an established writer by at least the late 1590's. And he had not yet written most of his great tragedies, such as *Hamlet*, *Othello*, *King Lear*, and *Macbeth*.

By the late 1590's, Shakespeare had not only become an established writer, but he had also become prosperous. In 1597, he purchased New Place, one of the two largest houses in Stratford. Shakespeare obviously remained a Stratford man at heart in spite of his busy, successful life in London. Records of business dealings and of minor lawsuits reveal that he preferred to invest most of his money in Stratford rather than in London.

The Globe Theatre. In 1599, Shakespeare and a small group of associates built the Globe, an outdoor theater in the London suburb of Southwark. The Globe was one of the largest theaters in the London area. It had a capacity of at least 2,500 persons.

Also in 1599, a printer named William Jaggard published *The Passionate Pilgrim*, a book of 20 poems supposedly written by Shakespeare. However, the book contained only two Shakespeare sonnets and three poems from his comedy *Love's Labour's Lost*. The printer used Shakespeare's name on the title page to promote the book's sale, which illustrates the playwright's popularity at that time.

The King's Men. In 1603, Queen Elizabeth I died and was succeeded by her cousin James VI of Scotland. As king of England, he became James I. James enjoyed and actively supported the theater. He issued a royal license to Shakespeare and his fellow players, which allowed the company to call itself the King's Men. In return for the license, the actors entertained the king at court on a somewhat regular basis.

James's support came at a convenient time. An outbreak of plague in 1603 had closed the theaters for long periods, making theatrical life uncertain. In fact, James's entry into London as king had to be postponed until 1604 because of the plague.

When James finally made his royal entry into London, the King's Men accompanied him. The members of the company were officially known as grooms of the chamber. In spite of this title and the name King's Men, the actors were not actually friends of the king. Their relationship to the royal court was simply that of professional entertainers.

The King's Men achieved unequaled success and became London's leading theatrical group. In 1608, the company leased the Blackfriars Theatre for 21 years. The theater stood in a heavily populated London district called Blackfriars. The Blackfriars Theatre had artificial lighting, was probably heated, and served as the company's winter playhouse. The King's Men performed at the Globe during the summer.

From 1599 to 1608 was a period of extraordinary literary activity for Shakespeare. During these years,

Jarrold Colour Publications

A Birthday Celebration in Stratford honors Shakespeare each April 23, the traditional date of his birth. The celebration includes a procession that passes the Guild Chapel, with its stone tower, and the adjoining Stratford grammar school.

he wrote several comedies and almost all the tragedies that have made him famous. Shakespeare's masterpieces during this period include the comedies *Much Ado About Nothing* and *Twelfth Night;* the history *Henry V;* and the tragedies *Antony and Cleopatra*, *Hamlet*, *Julius Caesar*, *King Lear*, *Macbeth*, and *Othello*.

The Sonnets. In 1609, a London publisher named Thomas Thorpe published a book called *Shakespeare's Sonnets*. The volume contained more than 150 sonnets that Shakespeare had written over the years. Scholars have long been especially curious about the dedication Thorpe wrote to the book. The dedication reads, in modernized spelling: "To the only begetter of these ensuing sonnets Mr. W. H." Generations of researchers have failed to identify Mr. W. H. Scholars have also analyzed the sonnets to determine to what extent they are autobiographical. But their analyses have proved contradictory and generally unsatisfactory. Many critics suggest that readers simply enjoy the sonnets as some of the finest verse in English literature instead of examining the poems as autobiographical statements. For additional information on the sonnets, see the section *Shakespeare's Poems*.

His Last Years

During his last eight years of life, Shakespeare wrote only four plays—*Cymbeline*, *Henry VIII*, *The Tempest*, and *The Winter's Tale*. In the past, some scholars argued that *The Tempest*, written about 1610, was Shakespeare's last play. They stated that he then retired almost completely to Stratford. However, *Henry VIII* can be dated about 1613. In addition, Shakespeare purchased a house in the Blackfriars district of London in 1613. The evidence thus suggests that Shakespeare gradually reduced his London activity rather than ending it abruptly.

Shakespeare must have divided his time between his private life in Stratford and his public life in London. He had lodgings in London at least until 1604 and probably until 1611. Yet such family events as his daughter Susanna's marriage in 1607 and his mother's death in 1608 would certainly have called him back to Stratford. By 1612, he may have been spending much of his time in the comforts of New Place in Stratford.

On Feb. 10, 1616, Shakespeare's younger daughter, Judith, married Thomas Quiney, the son of his Stratford neighbor Richard Quiney. Six weeks later, Shakespeare revised his will. Within a month, he died. He was buried inside the Stratford parish church. His monument records the day of death as April 23, the generally accepted date of his birth.

Shakespeare's son, Hamnet, died in 1596 at the age of 11. The playwright's daughter Susanna had one child, Elizabeth, who bore no children. Judith gave birth to three boys, but they died before she did. Shakespeare's last direct descendant, his granddaughter, Elizabeth, died in 1670.

The Anti-Stratfordians

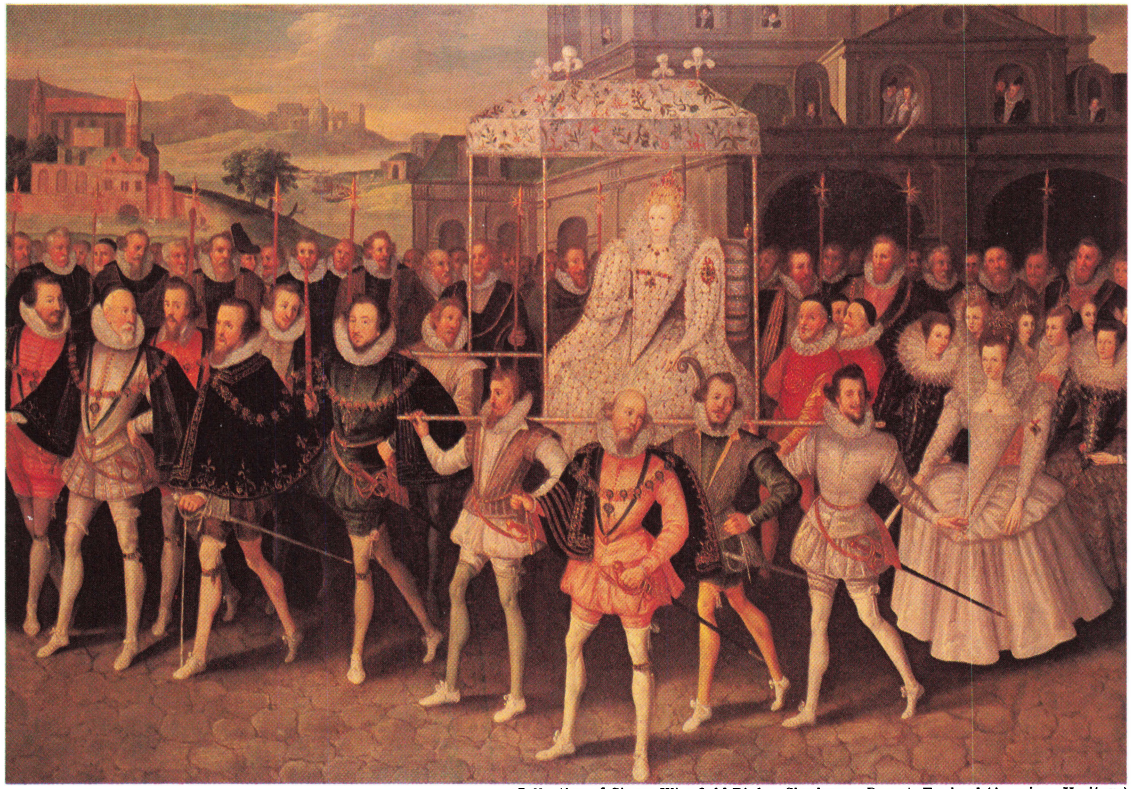
Through the years, the facts of Shakespeare's life have been confused with many tales based on hearsay and legend. During the 1800's in particular, admiration for Shakespeare grew so intense that it resulted in a totally uncritical attitude toward the man and his works. This attitude made him almost into a god.

British Tourist Authority

A Statue of Shakespeare stands in Stratford's Holy Trinity Church, where the playwright is buried. Scholars consider this statue and the engraving reproduced on page 269 to be the only authentic likenesses of Shakespeare.

Some people so admired Shakespeare's plays that they refused to believe an actor from Stratford-upon-Avon could have written them. Shakespeare's commonplace country background did not fit their image of the genius who wrote the plays. These people, called *anti-Stratfordians*, proposed several other Elizabethan writers as the author of Shakespeare's works. Almost all these writers were members of the nobility or upper class. The anti-Stratfordians believed that only an educated, sophisticated man of high social standing could have written the plays.

Sir Francis Bacon was the first and, for many years, the most popular candidate proposed as the real author of Shakespeare's plays. A claim that Bacon was the true author of Shakespeare's works appeared as early as 1769. Bacon's followers remain active today. But other anti-Stratfordians have had their own favorites. Edward de Vere, the 17th Earl of Oxford, is now more popular than Bacon. Other men to whom authorship has been credited include Roger Manners, the 5th Earl of Rutland; William Stanley, the 6th Earl of Derby; and Sir Walter Raleigh. Some anti-Stratfordians have also claimed that the writer Christopher Marlowe was the actual author. In spite of the claims made for these men, no important Shakespearean scholar doubts that Shakespeare wrote the plays and poems.



Collection of Simon Wingfield Digby, Sherborne, Dorset, England (American Heritage)

Queen Elizabeth I and Her Court lived in Shakespeare's London much of the time, adding color and excitement to the city's political and social life. This painting, completed about 1600 by an unknown artist, shows the queen and members of her court in a typical public appearance. Shakespeare's acting company performed many times before the queen and other members of the nobility.

Shakespeare's works reflect the cultural, social, and political conditions of the Elizabethan Age. Knowledge of these conditions can provide greater understanding of Shakespeare's plays and poems. For example, most Elizabethans believed in ghosts, witches, and magicians. No biographical evidence exists that Shakespeare held such beliefs, but he used them effectively in his works. Ghosts play an important part in *Hamlet*, *Julius Caesar*, *Macbeth*, and *Richard III*. Witches are major characters in *Macbeth*. Prospero, the hero of *The Tempest*, is a magician.

Shakespeare's London had nearly 200,000 persons in 1600. By modern standards, it was a crowded, unsanitary city. The unsanitary conditions led to frequent epidemics of plague, in which thousands of people died. Most houses were overcrowded, and the inner rooms dark and musty.

The crowded streets helped give London an air of bustling activity. But other factors also made London an exciting city. It was the commercial and banking center of England and one of the world's chief trading centers. London was also the capital of England. The queen and her dazzling court thus lived in the city for much of each year, adding to the color and excitement. The city's importance attracted people from throughout England and from other countries. Artists, courtiers, teachers, musicians, students, and writers all flocked to London to seek advancement.

Although large for its day, London was still small enough so that a person could be close to its cultural and political life. The wide range of knowledge that Shakespeare showed in his plays has amazed many of his admirers. Yet much of this knowledge was the kind that could be absorbed by being in the company of informed persons. The range of Shakespeare's learning and the variety of his characters probably reflect his deep involvement in London life.

Elizabethan Society. In the late 1500's, when Shakespeare began to write his plays, the English people tended to be optimistic. In 1588, the English navy won a great victory over the Armada, the huge Spanish fleet that tried to conquer England. The victory made England more secure and aroused strong feelings of patriotism. Following the triumph over the Armada, the English could agree with John of Gaunt in Shakespeare's *Richard II* that they were a "happy breed."

But the optimism of the late 1500's faded rapidly. By the time Queen Elizabeth died in 1603, the English were struggling with many social and economic problems. These problems were complicated by minor wars

with other countries—wars that seemed without purpose. To many English people, the world appeared to be deteriorating and becoming, in Hamlet's words, "an unweeded garden / That grows to seed."

Shakespeare's plays reflect the shift from optimism to pessimism in Elizabethan society. All his early plays, even the histories and the tragedy *Romeo and Juliet*, have an exuberance that sets them apart from the later works. After 1600, Shakespeare's dramas show the confused, gloomy, and often bitter social attitudes of the time. During this period, he wrote his greatest tragedies. Even the comedies *Measure for Measure* and *All's Well That Ends Well* have a bitter quality not found in his earlier comedies. A character in the tragedy *King Lear* cries out in despair, "As flies to wanton boys are we to the gods. / They kill us for their sport." These lines reflect the uncertainties of the time, as well as the uncertainties of a particular dramatic situation.

Elizabethans were keenly aware of death and the briefness of life. They lived in constant fear of plague. When an epidemic struck, they saw victims carted off to common graves. Yet death and violence also fascinated many Elizabethans. Londoners flocked to public beheadings of traitors, whose heads were exhibited on poles. They also watched as criminals were hanged, and they saw the corpses dangle from the gallows for days. Crowds also flocked to such bloodthirsty sports as bear-baiting and bullbaiting, in which dogs attacked a bear or bull tied to a post.

Elizabethan literature mirrored the violence and death so characteristic of English life. Shakespeare's tragedies, like other Elizabethan tragedies, involve the murder or suicide of many of the leading characters.

In spite of their tolerance of cruelty, Elizabethans were extremely sensitive to beauty and grace. They loved many forms of literature, including poetic drama, narrative and lyric poetry, prose fiction, and essays. People of all classes enjoyed music, and English composers rivaled the finest composers in all Europe.

Instrumental music, singing, and dancing are important in Elizabethan drama. Some of Shakespeare's romantic comedies might almost be called "musical comedies." *Twelfth Night*, for example, includes instrumental serenades and rousing drinking songs as well as other songs ranging from sad to comic. Dances form part of the action in *The Tempest*, *The Winter's Tale*, and *Romeo and Juliet*.

The English Ruler. Shakespeare's 10 history plays deal with English kings and nobility. Nine of the plays concern events from 1398 to the 1540's. A knowledge of these events and of the Elizabethans' attitude toward their ruler can help a playgoer or reader understand Shakespeare's histories.

During the 100 years before Elizabeth I became queen, violent political and religious conflicts had weakened the throne. From 1455 to 1485, a series of particularly bitter civil wars tore England apart. The wars centered on the efforts of two rival noble families—the House of Lancaster and the House of York—to control the throne. The wars are called the Wars of the Roses because Lancaster's emblem was said to be a red rose and York's a white rose. Four of Shakespeare's histories deal with the Wars of the Roses. These plays, in historical order, are *Henry VI*, Parts I, II, and III; and *Richard III*.

During the early 1500's, England was divided by a religious struggle. In 1534, Henry VIII broke with the Roman Catholic Church. His action led to the formation of the Church of England. In 1553, Queen Mary I re-established Catholicism as the state religion. But after Elizabeth I became queen in 1558, she re-established the Church of England.

As a result of the preceding 100 years of conflict, Elizabethans came to believe that a strong but just ruler was absolutely necessary to keep social order. In seeing Shakespeare's history plays, they would have understood his treatment of royal responsibilities as well as royal privileges. Elizabethans would have been aware of the dangers of a weak king—dangers that Shakespeare described in *Richard II*. They would also have been alert to the dangers of a cruel and unjust ruler, which Shakespeare portrayed in *Richard III*.

Woodcut (1557) by an unknown artist; Folger Shakespeare Library, Washington, D.C.

A Belief in Witches was common in Shakespeare's time. The playwright used witches as major characters in his tragedy *Macbeth*. This woodcut shows Macbeth and his friend Banquo meeting three witches on a lonely road. The illustration appeared in the *Chronicles* by the English historian Raphael Holinshed. Shakespeare used Holinshed's book as a basic source for *Macbeth* and many other plays.

Shakespeare wrote his plays to suit the abilities of particular actors and the tastes of specific audiences. The physical structure of the theaters in which his works were presented also influenced Shakespeare's playwriting. In addition, he used many dramatic devices that were popular in the Elizabethan theater but are no longer widely used. Modern readers and theatergoers can enjoy Shakespeare's plays more fully if they know something about the various theatrical influences that helped shape them.

Theater Buildings. By the late 1500's, Elizabethan plays were being performed in two kinds of theater buildings—later called *public* and *private* theaters. Public theaters were larger than private ones and held at least 2,500 persons. They were built around a courtyard that had no roof. Public theaters gave performances only during daylight hours because they had no artificial lights. Private theaters were smaller, roofed structures. They had candlelight for evening performances. Private theaters charged far higher prices and were designed to attract upper-class patrons. Because Shakespeare wrote most of his plays for public theaters, this section deals chiefly with the design and structure of such buildings.

In 1576, James Burbage built England's first public theater, called simply The Theatre. It stood in a suburb north of London, outside the strict supervision of London government authorities. Soon other public theaters were built in the London suburbs. These theaters included the Curtain, the Rose, and the Swan. In 1599, Shakespeare and his associates built the Globe Theatre. Detailed evidence of how the Elizabethan public theaters looked is limited. But scholars have been able to reconstruct the general characteristics of a typical public theater.

The structure that enclosed the courtyard of a public theater was round, square, or many-sided. In most theaters it consisted of three levels of galleries and probably stood about 32 feet (10 meters) high. The courtyard, called the *pit*, measured about 55 feet (17 meters) in diameter. The stage occupied one end of the pit. For the price of admission, the poorer spectators, called *groundlings*, could stand in the pit and watch the show. For an extra fee, wealthier patrons could sit on benches in the galleries.

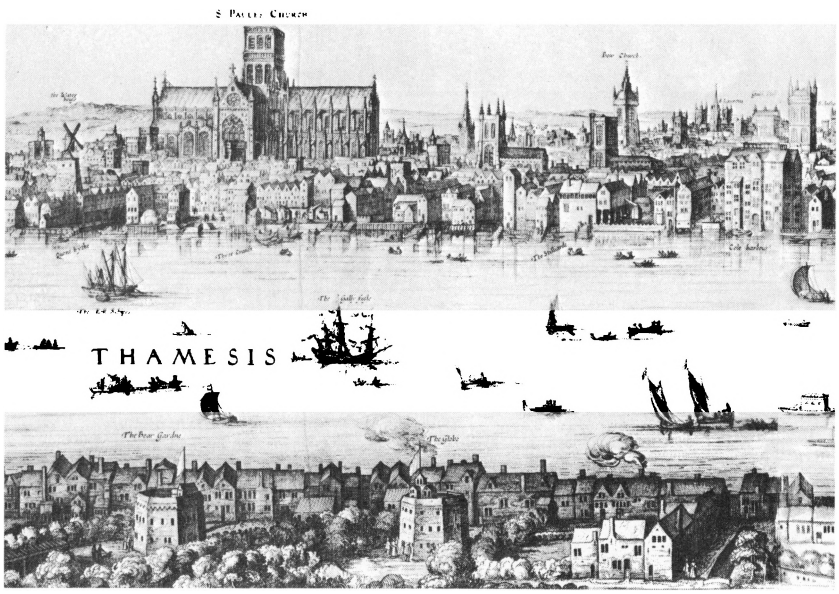
The Stage of a public theater was a large platform that projected into the pit. This arrangement allowed the audience to watch from the front and sides. The performers, nearly surrounded by spectators, thus had close contact with most of their audience.

Actors entered and left the stage through two or more doorways at the back of the stage. Behind the doorways were *tiring* (dressing) rooms. At the rear of the stage, there was a curtained *discovery* space. Scholars disagree about the details of this feature. But the space could be used to "discover"—that is, reveal—one or two characters by opening the curtains. Characters could also hide there or eavesdrop on conversations among characters up front on the main stage. The gallery that hung over the back of the main stage served as an upper stage. It could be used as a balcony or the top of a castle wall. The upper stage allowed Elizabethan dramatists to give their plays vertical action in addition to the usual horizontal movement.

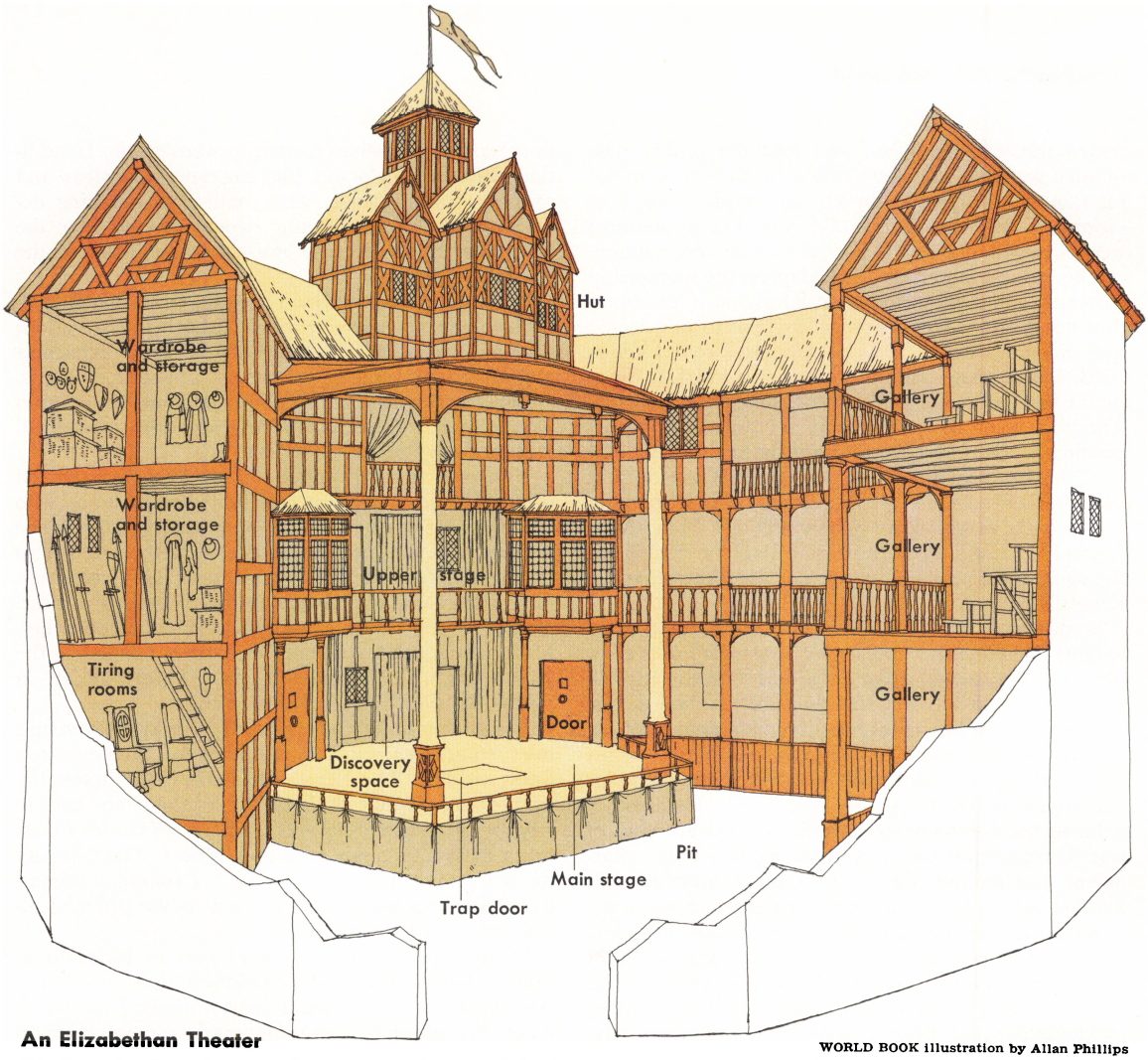
A half roof projected over the upper stage and the back part of the main stage. Atop the roof was a hut that contained machinery to produce sound effects and various special effects, such as the lowering of an actor playing a god. The hut was sometimes called the *heavens*. Two pillars supported the structure. The underside of the heavens was richly painted, and the interior of the theater undoubtedly had a number of other decorative features.

The main stage had a large trap door. Actors playing

Detail of *Long View of London* (1616), an engraving by Claes Jansz Visscher; British Museum, London



The Globe Theatre became the home of Shakespeare's acting company in 1599. It stood near the south bank of the River Thames in the London suburb of Southwark. The Globe is the many-sided building in the lower center of this illustration. A similar structure to the left is the Hope Theatre, sometimes called the Bear Garden.



An Elizabethan Theater

WORLD BOOK illustration by Allan Phillips

This illustration shows the general appearance of a typical Elizabethan public theater. The buildings were round, square, or many-sided. All were open at the top. Spectators stood in the pit or sat in the galleries. Actors performed on the main stage, in the discovery space, and on the upper stage. The hut atop the roof contained machinery to produce sound effects and various special effects.

the parts of ghosts and spirits could rise and disappear through the door. The trap door, when opened, could also serve as a grave.

Scenic Effects. Unlike most modern dramas, Elizabethan plays did not depend on scenery to indicate the *setting* (place) of the action. Generally, the setting was unknown to the audience until the characters identified it with a few lines of dialogue. In addition, the main stage had no curtain. One scene could thus follow another quickly because there was no curtain to close and open and no scenery to change. The lack of scenery also allowed the action to flow freely from place to place, as in modern motion pictures. The action of Shakespeare's *Antony and Cleopatra*, for example, shifts smoothly and easily back and forth between ancient Egypt and Rome.

Although the stage lacked scenery, various *props* were used, such as thrones, swords, banners, rocks, trees, tables, and beds. *Richard III* calls for two tents, one at each end of the stage.

Costumes and Sound Effects. The absence of scenery did not result in dull or drab productions. Acting companies spent much money on colorful costumes, largely to produce visual splendor. Flashing swords and swirling banners also added color and excitement.

Sound effects had an important part in Elizabethan drama. Trumpet blasts and drum rolls were common. Sometimes unusual sounds were created, such as "the noise of a sea-fight" called for in *Antony and Cleopatra*. Music also played a vital role. Shakespeare filled *Twelfth Night* with songs. In *Antony and Cleopatra*, the playwright included mysterious-sounding chords to set the mood before a fatal battle.

Acting Companies consisted of only men and boys because women did not perform on the Elizabethan stage. A typical acting company had 8 to 12 sharers, a number of salaried workers, and apprentices. The sharers were the company's leading actors as well as its stockholders. They had charge of the company's business activities. They bought plays and costumes,

rented theaters, paid fees, and split the profits. The salaried workers, who were called *hirelings*, took minor roles in the plays, performed the music, served as prompters, and did various odd jobs. The apprentices were boys who played the roles of women and children.

The acting companies operated under the sponsorship either of a member of the royal family or of an important nobleman. Most sponsorships were in name only and did not include financial support. From 1594 to 1603, Shakespeare's company was sponsored, in turn, by the first and second Lord Hunsdon, a father and son. The first Lord Hunsdon held the important court position of lord chamberlain until he died in 1596. In 1597, his son became lord chamberlain. Thus for most of the time from 1594 to 1603, Shakespeare's company was known as the Lord Chamberlain's Men. After James I became king of England in 1603, he singled out the company for royal favor. It was then known as the King's Men.

Shakespeare was unusual among Elizabethan playwrights. He not only wrote exclusively for his own company but also served as an actor and sharer in it. The close association between Shakespeare, his fellow actors, and the conditions of production had enormous influence on his dramas. Shakespeare wrote most of his plays with a particular theater building in mind and for performers he had frequently acted with. Each major actor in the company specialized in a certain type of role. For example, one played the leading tragic characters, and another the main comic characters. Still another actor played old men. Shakespeare wrote his plays to suit the talents of specific performers. He knew when he created a Hamlet, Othello, or King Lear that the character would be interpreted by Richard Burbage, the company's leading tragic actor. Burbage's father, incidentally, had built England's first public playhouse, The Theatre.

Shakespeare's comedies reveal the influence that specific actors had on the creation of his plays. From 1594 to 1599, the company's leading comic actor was Will Kempe. During this time, Shakespeare's chief comic characters reflected the broad humor of Kempe, who was known for his vaudeville style of singing and dancing. Shakespeare wrote such lively comedies as *A Midsummer Night's Dream* and *Much Ado About Nothing* with Kempe in mind. After Kempe left the company, Robert Armin took his place, and the style of Shakespeare's comedy shifted noticeably. The playwright skillfully used Armin's more sophisticated and intellectual comic talents in such lively but thoughtful comedies as *Twelfth Night* and *As You Like It*.

Elizabethan acting companies required plays that had roles for all the major performers. Partly for this reason, comic scenes appear in even the most violent of Shakespeare's tragedies. Many of these scenes were included simply to give the company's leading comic actor a role. The first gravedigger in *Hamlet* and the porter in *Macbeth* are examples of comic characters in Shakespeare's tragedies.

Scholars still debate the exact nature of Elizabethan acting style. Yet Elizabethan actors probably performed much as actors do today. However, they spoke their lines more rapidly than modern performers do. In addition, Elizabethan actors had an especially clear and musical speaking style. This method of speaking developed from years of acting experience and from the Elizabethan love for the musical possibilities of the English language.

Dramatic Conventions. The writing and staging of Elizabethan plays were strongly influenced by various dramatic *conventions* (customs) of that time. The most widespread convention was the use of poetic dialogue. Although Shakespeare's plays contain prose and rhymed verse, he chiefly used an unrhymed, rhythmical form of poetry called *blank verse*.

Two common conventions that audiences expected were *soliloquies* and *asides*. In a soliloquy, an actor, who is alone on the stage, recites a speech directly to the audience. Or he speaks aloud to himself his thoughts and feelings. In an aside, a character speaks words that the other characters onstage are not supposed to hear. Audiences also liked and expected long lyrical speeches. Many of these speeches had little direct relation to the play's action. Mercutio's "Queen Mab" speech in *Romeo and Juliet* is a famous example.

The convention of boy apprentices playing women's roles contributed directly to some of Shakespeare's finest writing. The "boy actresses" were thoroughly trained and highly skilled. But Shakespeare had to rely on the magic of his verse rather than the loveliness of an actress to create feminine appeal. The "Beauty too rich for use, for earth too dear" of Juliet lay primarily in Shakespeare's language, not in the physical attractions of the performer.

Disguise played an important part in Elizabethan drama. Audiences enjoyed comic situations in which a boy played a girl character who disguised herself as a boy. Female characters masquerade as men in several of Shakespeare's plays, including *As You Like It*, *The Merchant of Venice*, and *Twelfth Night*. Social conditions also made disguise an effective theatrical device in Elizabethan times. The Elizabethans recognized sharp distinctions between social classes and between occupations. These distinctions were emphasized by striking differences in dress. Noblemen were immediately recognized by their clothing, as were doctors, lawyers, merchants, or pages. Characters could thus easily disguise themselves by wearing the garments of a certain social class or occupation.

Shakespeare's Audiences. Shakespeare wrote most of his plays for audiences with a broad social background. To the Globe Theatre came a cross section of London society, ranging from apprentices playing hooky from work to members of the nobility passing the time. But most of the Globe's audience consisted of middle-class citizens, such as merchants and craftsmen and their wives. They went to the theater for the same reasons most people today go to the movies—to relax and to escape for a while from their cares.

Shakespeare's plays were also produced at the royal court, in the houses of noblemen, and sometimes in universities and law schools. For most of his career, he thus wrote plays that had to appeal to people of many backgrounds and tastes.

Paul Robeson and Uta Hagen in a scene from *Othello;* New York Public Library at Lincoln Center, Astor, Lenox and Tilden Foundations

Othello was written during Shakespeare's third period, when he created his greatest tragedies. The play concerns Othello, a black Moorish general, who marries a younger woman, Desdemona. Tricked into believing she has been unfaithful, Othello kills her.

Most scholars agree that there exist 37 plays by Shakespeare. A number of scholars have argued that Shakespeare also wrote all or part of certain other existing or lost plays. However, only one of these works, *The Two Noble Kinsmen*, has gained any acceptance. Many scholars believe that Shakespeare wrote the play with another English dramatist, John Fletcher. But most scholars omit this work from the accepted list of Shakespeare's dramas.

Much Shakespearean research has been devoted to determining the order in which Shakespeare's plays were written and first performed. The Elizabethans kept no records of premières of plays, and no newspapers existed to provide opening-night reviews. All Shakespeare's known plays were eventually published, but the publication date is not necessarily the date of a play's composition or première.

To establish the order in which Shakespeare's plays were probably written and first performed, scholars have relied on a variety of literary and historical evidence. This evidence includes records of performances, mention of Shakespeare's works by other Elizabethan writers, and references in Shakespeare's plays to events of the day. Scholars can also roughly date a play by Shakespeare's literary style. But for many of the plays, precise dates remain uncertain.

Traditionally, Shakespeare's plays have been divided into three groups—comedies, histories, and tragedies. At each stage of his career, Shakespeare tended to concentrate on a certain kind of drama, depending on the tastes of his audience at that time. For example, he wrote 9 of his 10 histories during a period when such plays were especially popular.

Shakespeare generally followed the Elizabethan custom of basing his plots on published historical and literary works. But he differed from most other dramatists in one important way. In retelling a story, Shakespeare shaped the borrowed material with such genius that he produced a work of art that was uniquely different from its source.

This section describes the plots and notable characteristics of all Shakespeare's plays. The plays have been divided into four periods, each of which reflects a general phase of Shakespeare's artistic development. Within each period, the plays are discussed in the order in which they were probably first performed.

For readers interested in a specific play or plays, the following table lists the plays alphabetically and gives the period in which a description of each play may be found.

Play	Period
All's Well That Ends Well	Third
Antony and Cleopatra	Third
As You Like It	Second
Comedy of Errors, The	First
Coriolanus	Third
Cymbeline	Fourth
Hamlet	Third
Henry IV, Parts I and II	Second
Henry V	Second
Henry VI, Parts I, II, and III	First
Henry VIII	Fourth
Julius Caesar	Second
King John	First
King Lear	Third
Love's Labour's Lost	Second
Macbeth	Third
Measure for Measure	Third
Merchant of Venice, The	Second
Merry Wives of Windsor, The	Second
Midsummer Night's Dream, A	Second
Much Ado About Nothing	Second
Othello	Third
Pericles	Third
Richard II	Second
Richard III	First
Romeo and Juliet	Second
Taming of the Shrew, The	First
Tempest, The	Fourth
Timon of Athens	Third
Titus Andronicus	First
Troilus and Cressida	Third
Twelfth Night	Second
Two Gentlemen of Verona, The	First
Winter's Tale, The	Fourth

The First Period (1590-1594)

The plays of Shakespeare's first period have much in common, though they consist of comedies, histories,

and a tragedy. The plots of these plays tend to follow their sources more mechanically than do the plots of Shakespeare's later works. The plots also tend to consist of a series of loosely related episodes, rather than a closely integrated dramatic structure. In addition, the plays generally emphasize events more than the portrayal of character.

In his first period, Shakespeare's use of language indicates that he was still struggling to develop his own flexible poetic style. For example, his descriptive poetry is apt to be flowery, rather than directly related to the development of the characters or the story.

The Comedy of Errors, a comedy partly based on *Amphitruo* and *Menaechmi*, two comedies by the ancient Roman playwright Plautus. Probably first performed during the period from 1590 to 1594. First published in 1623.

The action in *The Comedy of Errors* takes place in the ancient Greek city of Ephesus. The plot deals with identical twin brothers, both named Antipholus. Each brother has a servant named Dromio, who also happen to be twin brothers. The twins of each set were separated as children, and neither twin knows where his brother is living. One twin and his servant live in Ephesus. Their brothers live in Syracuse. After Antipholus and Dromio of Syracuse arrive in Ephesus, a series of mistaken identities and comical mix-ups develops before the twin brothers are reunited.

The comedy has little character portrayal or fine poetry. But the plot is filled with intrigue and broad humor, which make the play highly effective theater.

Henry VI, Parts I, II, and III, three related histories partly based on *The Union of the Two Noble and Illustrious Families of Lancaster and York* by the English historian Edward Hall and on the *Chronicles* by the English historian Raphael Holinshed. Each part probably first performed during the period from 1590 to 1592. Part I published in 1623, Part II in 1594, and Part III in 1595.

The three parts of *Henry VI* present a panoramic view of English history in the 1400's. The action begins with the death of King Henry V in 1422. It ends with the Battle of Tewkesbury in 1471. The plays vividly mirror the Wars of the Roses—the series of bloody conflicts between the houses of York and Lancaster for control of the English throne. Part I deals largely with wars between England and France. But all three plays dramatize the plots and counterplots that marked the struggle between the two royal houses.

The *Henry VI* plays are confusing to read because of their large and shifting casts of characters. The plays have much greater impact when performed than when read. On the stage, the constant action, exaggerated language, and flashes of brilliant characterization result in lively historical drama.

Richard III, a history partly based on *The Union of the Two Noble and Illustrious Families of Lancaster and York* by the English historian Edward Hall and on the *Chronicles* by the English historian Raphael Holinshed. Probably first performed in 1593. First published in 1597.

The play deals with the end of the Wars of the Roses. It opens with the hunchbacked Richard, Duke of Gloucester, confiding his villainous plans to the audience. He addresses the audience in a famous soliloquy that begins, "Now is the winter of our discontent / Made glorious summer by this sun of York." Richard refers to the success of his brother Edward, Duke of York. Edward has overthrown Henry VI of the House of Lancaster and taken the English throne. Now weak and ill, he rules England as Edward IV. Richard wants to gain the crown for himself. He has his other brother, the Duke of Clarence, murdered. After King Edward dies, Richard sends the Prince of Wales, the dead king's older son, and the prince's brother to the Tower of London. After seizing the throne as Richard III, he has the two boys murdered.

Before long, Richard's allies turn against him and join forces with the Earl of Richmond, a member of the House of Lancaster. Richmond's forces defeat Richard's army at the Battle of Bosworth Field. Richard utters the famous cry "A horse! a horse! my kingdom for a horse!" as his mount is slain during the battle. Richmond finally kills Richard and takes the throne as King Henry VII.

The character of Richard is a superb theatrical portrait of total evil. But Richard blends his wickedness with such wit that his plotting becomes a delight to watch. On a deeper level, *Richard III* reminds audiences that when evil flourishes, society in general is to blame. People can be freed from the evil around them only when they themselves live up to the demands they make of their leaders.

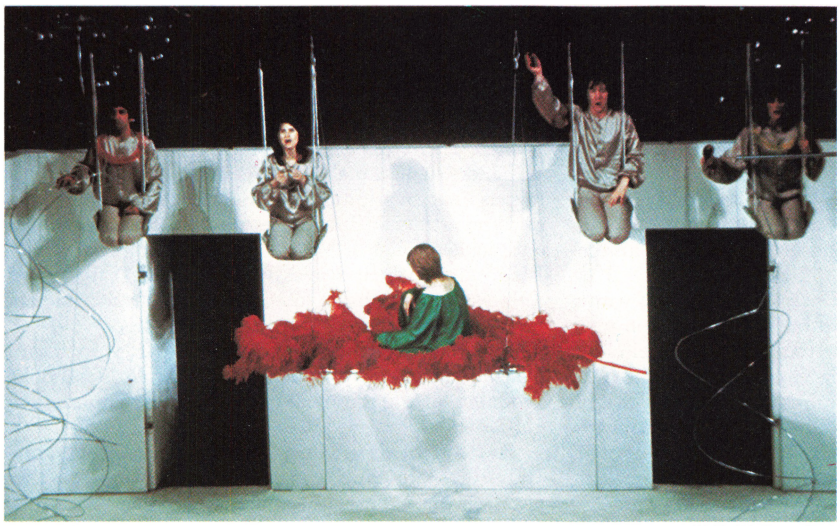
The Taming of the Shrew, a comedy partly based on *The Taming of a Shrew*, a comedy by an unknown English playwright, and on *Supposes*, a comedy by the English author George Gascoigne. Probably first performed in 1593. First published in 1623.

This play dramatizes how Petruchio, a young Italian gentleman, woos the beautiful but *shrewish* (bad tempered) Katherine, whose biting tongue has discouraged other suitors. Petruchio marries her. But before and after the wedding, he systematically humiliates Katherine to cure her of her temper. After many comical clashes between the two, Petruchio's strategy succeeds and Katherine becomes an obedient wife. At this point, Petruchio reveals himself to be a true gentleman and genuinely fond of Katherine.

A broad and vigorous comedy, *The Taming of the Shrew* provides two outstanding roles in the characters of the battling lovers. The parts of Petruchio and Katherine have been a showcase for generations of gifted actors and actresses.

Titus Andronicus, a tragedy possibly based in part on *The History of Titus Andronicus*, a story by an unknown English author. Probably first performed about 1594. First published in 1594.

This play is a type of melodrama that was popular in Elizabethan theater. The action takes place in and around ancient Rome. It involves a series of brutal acts of revenge by the Roman general Titus Andronicus against the men who raped his daughter, Lavinia. Shakespeare only occasionally lightened the play's bloody sensationalism with effective poetry and char-



Holte Photographics

A Midsummer Night's Dream **is a comedy that mixes realistic humor with scenes involving fairies and enchanted lovers. England's Royal Shakespeare Company gained acclaim for its imaginative interpretation of the play. This scene from the company's production shows fairies singing Titania, their queen, to sleep.**

acterization. The evil plots of Aaron the Moor provide most of the interest in an otherwise continuous parade of horror and violence.

The Two Gentlemen of Verona, a comedy partly based on *Diana*, a story by the Spanish author Jorge de Montemayor, and on *The Book of the Governor*, an educational work by the English author Sir Thomas Elyot. Probably first performed in 1594. First published in 1623.

The play is a witty comedy of love and friendship. It takes place in Italy. Two friends from Verona, Valentine and Proteus, meet in Milan. They become rivals for the love of Silvia, the daughter of the Duke of Milan. Valentine discovers Proteus as his friend is about to force his attentions on Silvia. Proteus repents his action, and Valentine forgives him. Valentine then tells his friend he can have Silvia. But Valentine's generosity becomes unnecessary. Proteus learns that Julia, his former mistress, has followed him to Milan disguised as a page. Proteus finds that he really loves Julia. He marries her at the end of the play, and Valentine marries Silvia.

In *The Two Gentlemen of Verona*, Shakespeare introduced several features and devices that he later used so effectively in the great romantic comedies of his second period. For example, he included beautiful songs, such as "Who Is Silvia?"; scenes in a peaceful, idealized forest; and a girl, disguised as a page, braving the dangers of the world.

King John, a history probably based in part on *The Troublesome Reign of John, King of England*, a play by an unknown English author. Probably first performed about 1594. First published in 1623.

The story concerns the efforts of England's King John to defend his throne against the claims of Arthur, the young Duke of Brittany. The powerful king of France supports Arthur. John has the allegiance of the brave and able Philip Faulconbridge and of the English nobility. But in time, John's evil and weak policies cost him the loyalty of his followers. Near the end of the play, both Arthur and John die violently. John's son then takes the throne as Henry III.

The most interesting character in *King John* is Faulconbridge. His sarcastic and witty comments on the personalities and motives of the other characters provide the play's best dialogue.

The Second Period (1595-1600)

During his second period, Shakespeare brought historical drama and Elizabethan romantic comedy to near perfection. Particularly in his histories and comedies of this period, he demonstrated his genius for weaving various dramatic actions into a unified plot, rather than writing a series of loosely connected episodes. Throughout the period, Shakespeare moved steadily toward the matchless gift for characterization that marks his great tragedies of the early 1600's.

A Midsummer Night's Dream, a comedy probably based on several sources, none of which was a chief source. Probably first performed in 1595. First published in 1600.

The play begins in Athens, Greece, with preparations for a wedding between Theseus, Duke of Athens, and Hippolyta, queen of the Amazons. But most of the action takes place in an enchanted forest outside Athens. In the forest, two young men, Lysander and Demetrius, and two young women, Hermia and Helena, wander about together after they become lost. Lysander and Demetrius both love Hermia and ignore Helena, who loves Demetrius. Oberon, king of the fairies, orders the mischievous elf Puck to anoint Demetrius' eyes with magic drops that will make him love Helena. However, Puck mistakenly anoints Lysander's eyes, creating much comic confusion. Puck finally straightens out the mix-up.

In a subplot, Oberon quarrels with Titania, his queen. He anoints Titania's eyes with the magic drops while she sleeps so that when she awakens, she will love the first living thing she sees. At this time, Nick Bottom, a weaver, and his comical friends are rehears-

ing a foolish play they plan to present at the duke's wedding. When Titania awakens, she sees Bottom and immediately falls in love with him. To increase her humiliation, Oberon gives Bottom the head of a donkey. Aided by her fairy attendants, Titania woos Bottom until Oberon takes pity on her and has Puck remove the spell. The play ends with the duke's wedding, at which the two young couples—Lysander and Hermia and Demetrius and Helena—also marry. Bottom and his friends perform their hilariously silly play at the wedding celebration.

For *A Midsummer Night's Dream*, Shakespeare wrote some of his most richly descriptive poetry. Oberon tells Puck, "I know a bank where the wild thyme blows / Where oxlips and the nodding violet grows." The passage transports the audience in imagination to a magic wood where flowers bloom and fairies play. Shakespeare balanced the romantic fantasy with the rough humor of Bottom and his friends. The self-centered Bottom ranks as one of Shakespeare's finest comic figures. The comedy also has a serious side. Gaily but firmly, it makes fun of romantic love. As Puck comments, "Lord, what fools these mortals be!"

Richard II, a history partly based on the *Chronicles* by the English historian Raphael Holinshed. Probably first performed in 1595. First published in 1597.

As the play begins, King Richard exiles his cousin Bolingbroke from England. Later, Richard seizes Bolingbroke's property. While Richard fights rebels in Ireland, Bolingbroke returns to England and demands his property. After Richard learns of Bolingbroke's return, he hurries back to England to find his cousin leading a force of nobles who are discontented with Richard's rule. Instead of preparing the royal army to fight Bolingbroke, Richard wastes his time in outbursts of self-pity. He finally gives up his crown to Bolingbroke without a fight. Bolingbroke then orders that Richard be put in prison.

After Bolingbroke is crowned Henry IV, the imprisoned Richard is killed by a knight who mistakenly believed that the new king wanted Richard murdered. At the end of the play, Henry vows to make a journey to the Holy Land to pay for Richard's death.

In *Richard II*, Shakespeare seriously explored for the first time the idea that a person's character determines his fate. The play is a study of a weak, self-centered man. Richard becomes so out of touch with reality that his only defense of his kingdom is the hope that his "master, God omnipotent, / Is mustering in his clouds on our behalf / Armies of pestilence." When he faces the certain loss of his crown, Richard can only compare himself to Christ, who "in twelve, / Found truth in all but one; I, in twelve thousand none."

Love's Labour's Lost, a comedy probably based on several sources, none of which was a chief source. Probably first performed in 1596. First published in 1598.

King Ferdinand of Navarre and his friends Berowne, Longaville, and Dumain vow to live without the company of women for three years. But the princess of France unexpectedly arrives at the king's court with three female companions. The comedy centers on the efforts of the men to woo the women while pretending to keep their vow. At the play's end, the men propose to their visitors, who promise to give their answer in a year and a day.

This witty comedy has more references to events of the day than do any of Shakespeare's other plays. Many of these references have lost their meaning for modern audiences, which makes numerous passages difficult to understand. In addition, much of the language is elaborate and artificial. But Shakespeare included two simple and lovely songs—"When Daisies Pied and Violets Blue" and "When Icicles Hang by the Wall." *Love's Labour's Lost* also has handsome scenes of spectacle and several entertaining comic characters.

Romeo and Juliet, a tragedy based partly on *Romeus and Juliet*, a poem by the English author Arthur Brooke. Probably first performed in 1596. First published in 1597.

The story deals with two teen-aged lovers in Verona, Italy, who are caught in a bitter feud between their families, the Montagues and the Capulets. Romeo, a Montague, and his friends crash a masked ball given by the Capulets. At the ball, Romeo meets Juliet, a Capulet, and they fall in love. The next day, the couple are secretly married by Friar Laurence. Returning from the wedding, Romeo meets Juliet's cousin Tybalt, who tries to pick a fight with him. But Romeo refuses to fight his new relative. To defend the Montague honor, Romeo's friend Mercutio accepts Tybalt's challenge. As Romeo attempts to part the young men, Tybalt stabs Mercutio to death. In revenge, Romeo then fights and kills Tybalt. As a result of Tybalt's death, Romeo is exiled from Verona.

Juliet's father tries to force her to marry her cousin Paris, unaware that she is already married. To allow Juliet to escape from her father's demand, Friar Laurence gives Juliet a drug that puts her into a death-like sleep for 42 hours. The friar sends a messenger to the exiled Romeo to tell him of the drug, but the messenger is delayed. Romeo hears that Juliet is dead and hurries to the tomb where she has been placed. There, he takes poison and dies by Juliet's side. Juliet awakens to find her husband dead and stabs herself. The discovery of the dead lovers convinces the two families that they must end their feud.

The popularity of *Romeo and Juliet* owes much to Shakespeare's sympathy for the young people in the play. Shakespeare seemed to blame the tragic ending on the blind self-interest of the adults. The success of the play also comes from effective characterizations and intensely lyrical poetry. Although frequently artificial, Shakespeare's language shows signs of the simpler, more direct style he would use in his later tragedies. For example, as Romeo watches Juliet on the balcony outside her bedroom, he sighs:

> See how she leans her cheek upon her hand!
> Oh, that I were a glove upon that hand,
> That I might touch that cheek!

The Merchant of Venice, a comedy partly based on a story in *Il Pecorone*, a collection of tales by the Italian author Giovanni Fiorentino. Probably first performed in 1597. First published in 1600.

Antonio, a merchant in Venice, Italy, borrows money

from the Jewish moneylender Shylock and then lends the money to his friend Bassanio. Antonio has promised Shylock a pound of his flesh if he does not repay the loan in three months. The three months pass, and Shylock demands his money. But Antonio cannot pay. Shylock then demands the pound of flesh.

Meanwhile, Bassanio has courted and married the beautiful and gifted heiress Portia. She has a plan to save Antonio from Shylock. Shylock goes to court to demand the flesh. Portia, disguised as a learned lawyer, asks him to reconsider in a famous speech that begins, "The quality of mercy is not strained." Shylock remains firm. Portia then warns him that he may take Antonio's flesh but not his blood. If Shylock spills any blood in taking the flesh, he will lose his property. Shylock drops his demand, and Antonio is saved.

In *The Merchant of Venice*, Shakespeare combined comic intrigue with a vivid portrait of hatred and greed. Although the play ends happily for everyone except the revengeful Shylock, it is not a light-hearted comedy. In Shakespeare's time, both the church and the state considered moneylending at high interest a crime. Shylock was thus a natural object of scorn. On the surface, Shakespeare's view of him reflected the attitudes of the day. But the dramatist treated the moneylender as a very human and even sympathetic person. For example, Shakespeare provided Shylock with an eloquent statement of how it feels to be part of a harshly treated minority: "If you prick us, do we not bleed? If you tickle us, do we not laugh? If you poison us, do we not die? And if you wrong us, shall we not revenge?"

Henry IV, Parts I and II, two related histories partly based on the *Chronicles* by the English historian Raphael Holinshed and on *The Famous Victories of Henry the Fifth*, a play by an unknown English author. Part I probably first performed in 1597. First published in 1598. Part II probably first performed in 1598. First published in 1600.

Scene from *Henry IV*, Part I, at the Stratford Festival Theatre, Ont. (De Wys)

Henry IV, a two-part history, is noted for the character of Sir John Falstaff, one of Shakespeare's greatest comic figures. In the plays, Falstaff, *right*, spends much of his time drinking and clowning with his boisterous friends at the Boar's Head Inn.

The two parts of *Henry IV* dramatize events that follow the murder of England's King Richard II. In Part I, the guilt-ridden Henry IV wants to go to the Holy Land in repentance for Richard's death. But constant political unrest in England prevents him. At the same time, Prince Hal, his son, leads an apparently irresponsible life with his brawling friends, led by the fat, jolly knight Sir John Falstaff. Falstaff's clowning provides most of the play's humor. The king quarrels with Henry Percy, known as Hotspur, who is the fiery young son of the powerful Earl of Northumberland. As a result of the quarrel, the Percy family revolts. At the Battle of Shrewsbury, Hal reveals himself to be a brave and princely warrior and kills Hotspur.

Part II of *Henry IV* also has many scenes of Falstaff's clowning. These scenes are set against the background of the continuing Percy rebellion and the approaching death of the ill Henry IV. Hal's brother, Prince John, finally defeats the rebels. The king dies, and Hal takes the throne as Henry V. He immediately reveals his royal qualities and rejects Falstaff and his friends, telling them to avoid him until they have abandoned their wild living.

Of the two plays, Part I is more memorable. It introduces Falstaff, best characterized by his comment in Part II that "I am not only witty in myself, but the cause that wit is in other men." Falstaff is a bragging, lying, and thievish drunkard. But his faults are balanced by his clever sense of humor, his contagious love of life, and his refusal to take neither himself nor the world seriously. Falstaff ranks as one of the great comic roles in the theater.

As You Like It, a comedy partly based on *Rosalynde*, a novel by the English author Thomas Lodge. Probably first performed in 1599. First published in 1623.

Rosalind and her cousin Celia leave the court of Celia's father, Duke Frederick, after he unjustly banishes Rosalind. Accompanied by Touchstone, the court jester, the two girls take refuge in the Forest of Arden. Also in the forest are Orlando, who loves Rosalind; Jaques, a melancholy philosopher; Audrey, a country girl; Silvius, a shepherd; and Phebe, a shepherdess. Duke Frederick's brother, who is Rosalind's father and the rightful ruler of Frederick's land, also lives in the forest. He leads a band of merry outlaws.

Rosalind, disguised as a young shepherd named Ganymede, meets Orlando in the forest. Not recognizing the disguised girl, Orlando agrees to pretend that Ganymede is Rosalind so he can practice his declarations of love. Rosalind finally reveals her identity and marries Orlando. Touchstone marries Audrey, and Silvius marries Phebe. The news that Rosalind's father has been restored to his dukedom completes the comedy's happy ending.

Like many other Elizabethan romantic comedies, *As You Like It* concerns young lovers who pursue their happy destiny in a world seemingly far removed from reality. Although evil threatens, it never harms. Shakespeare enriched the play with beautiful poetry as well as several charming songs.

Shakespeare consistently balanced the gay laughter of *As You Like It* with notes of seriousness and even sadness. Touchstone's wit and Jaques's remarks question the nature of love and the values of society. The play discusses the advantages and disadvantages of city and country life. Jaques adds a strong note of melancholy to the play with his famous description of the seven ages of man. At the end of the description, he claims that man's final fate is "second childishness and mere oblivion, / Sans [without] teeth, sans eyes, sans taste, sans everything."

Henry V, a history partly based on the *Chronicles* by the English historian Raphael Holinshed and on *The Famous Victories of Henry the Fifth,* a play by an unknown English author. Probably first performed in 1599. First published in 1600.

The play continues the action of *Henry IV,* Part II, and presents an idealized portrait of England's King Henry V. The king decides to press a claim he believes he has to the French throne. He heads an army that lands in France. Inspired by Henry's leadership, the outnumbered English troops defeat the French at the town of Harfleur. The two armies then meet in battle near the village of Agincourt. Against overwhelming odds, the English win a great victory. The triumphant Henry is received at the French court. There he is promised the throne and the hand of Katharine, a French princess with whom he had fallen in love.

The play consists of loosely related episodes unified by the character of the brave but modest king. Shakespeare filled *Henry V* with patriotic passages, especially the king's famous address to his troops at Harfleur. It begins, "Once more unto the breach, dear friends, once more." The speech concludes, "The game's afoot! / Follow your spirit; and upon this charge / Cry 'God for Harry! England and Saint George!' "

Henry claims to hate war in general. Yet he finds himself carried away by the glamour and glory of the French campaign. Although the play occasionally seems to glorify war, Shakespeare set the heroics against a background of political treachery and empty honor. Comic scenes mock the vanity of the royal court. They remind audiences that kings and their councils plan wars, but ordinary men fight and die in them.

Julius Caesar, a tragedy partly based on *Lives* by the ancient Greek biographer Plutarch, as translated by the English writer Sir Thomas North. Probably first performed in 1599. First published in 1623.

The play takes place in ancient Rome and concerns events before and after the assassination of the Roman ruler Julius Caesar. In spite of its title, the play's central character is Brutus, a Roman general and Caesar's best friend. Brutus reluctantly joins a plot to murder Caesar because he believes Rome's safety requires his death. The plotters attack Caesar in the Roman Senate. He resists until he sees Brutus. Caesar's last words are "Et tu, Brute? [You too, Brutus?] Then fall, Caesar!"

Brutus defends the assassination to a crowd of Romans. But he unwisely allows the clever and eloquent Mark Antony to deliver a funeral speech over Caesar's body. Antony tells the people, "I come to bury Caesar, not to praise him." He then describes the plotters with heavy sarcasm as "honorable men." At the same time, he points out Caesar's virtues and so gradually turns the crowd into a mob ready to burn and kill to avenge Caesar's death. The plotters flee Rome.

Mark Antony leads an army that defeats the forces of the plotters at the Battle of Philippi. At the end of the battle, Brutus commits suicide. Over his corpse, Antony states, "This was the noblest Roman of them all." Antony says that the other plotters killed Caesar out of envy but only Brutus acted with "honest thought / And common good to all."

The play has become popular because of its magnificent language and sharp character portraits. For example, Caesar describes the plotter Cassius as having a "lean and hungry look." But the real interest in *Julius Caesar* centers on Brutus. A thoughtful, withdrawn man, he is torn between his affection for Caesar and his strong sense of duty to the state.

Much Ado About Nothing, a comedy partly based on *Orlando Furioso,* an epic poem by the Italian author Ludovico Ariosto, and on a story in *Novelle,* a collection of tales by the Italian author Matteo Bandello. Probably first performed in 1599. First published in 1600.

This romantic comedy concerns attempts by the villainous Don John to slander the virtue of Hero, the daughter of the governor of Messina, Italy. After much intrigue, the play ends happily. But the real interest in *Much Ado About Nothing* centers on the relationship between Beatrice and Benedick, two witty young people who trade insults throughout most of the play. Their arguments and final discovery that they love each other provide much of the fun. Adding to the gaiety is the broad humor of the talkative village constable, Dogberry, and his assistant, Verges.

Twelfth Night, a comedy partly based on a story in *Farewell to Military Profession,* a collection of tales by the English author Barnabe Riche. Probably first performed in 1600. First published in 1623.

Viola and Sebastian, who are twins, become separated during a shipwreck. Viola finds herself stranded in the country of Illyria. She disguises herself as Cesario, a page, and enters the service of Duke Orsino. The duke sends the page to woo the countess Olivia for him. But the countess falls in love with Cesario. Meanwhile, the page only complicates matters further by falling in love with the duke.

The romantic action alternates with scenes of realistic comedy involving the fat knight Sir Toby Belch and his friends. One friend, Sir Andrew Aguecheek, fights Cesario in a comic duel. Maria, Olivia's lady-in-waiting, tricks the countess' steward, Malvolio, into thinking that Olivia loves him. The plot becomes increasingly tangled until Sebastian, Viola's twin brother, appears. Viola then reveals her identity, and the confusion is resolved. Orsino marries Viola, and Sebastian marries Olivia. Only Malvolio is left unhappy.

In *Twelfth Night,* Shakespeare created a perfect blend of sentiment and humor. In addition, he provided Feste, Olivia's clown, with witty comments on the foolish ways of people. Feste's songs contribute both gaiety and sadness to the mood of the play. In one famous song, he reminds the audience that they should

Scene from a New York Shakespeare Festival production (George E. Joseph)

Much Ado About Nothing **is a romantic comedy that centers on Beatrice and Benedick, *left*, two witty young people who trade insults until they finally realize they love each other. In the production above, the setting has been changed from Italy to the United States in the late 1890's.**

enjoy the present because nobody can know what the future will bring:

What is love? 'Tis not hereafter;
Present mirth hath present laughter;
What's to come is still unsure:
In delay there lies no plenty;
Then come kiss me, sweet and twenty!
Youth's a stuff will not endure.

Only Malvolio, who thinks he is more moral than other people, spoils the gentle mood of the play. Sir Toby Belch angrily asks him, "Dost thou think, because thou art virtuous, there shall be no more cakes and ale?" The comedy also contains the famous passage "Some are born great, some achieve greatness, and some have greatness thrust upon 'em."

The première of *Twelfth Night* probably took place on the Christian festival known as the Epiphany or Twelfth Night. The festival occurs 12 days after Christmas.

The Merry Wives of Windsor, a comedy possibly based on an unknown source or sources. Probably first performed in 1600. First published in 1602.

This play represents Shakespeare's only attempt to write a realistic comedy. According to a popular though unproven story, Queen Elizabeth requested the play. She so enjoyed the comic character Sir John Falstaff in the *Henry IV* plays that she asked Shakespeare to write a comedy portraying Falstaff in love. The comedy dramatizes Falstaff's efforts to make love to Mistress Ford and Mistress Page, two honest middle-class housewives in the town of Windsor. Instead, Falstaff ends up the victim of a number of comical tricks invented by the women.

Although *The Merry Wives of Windsor* lacks the romantic poetry of most Shakespearean comedies, the play is highly entertaining. The Falstaff in this work has less imagination and wit than the Falstaff in the *Henry IV* plays. But the character remains theatrically effective, even though the audience laughs at him rather than with him, as in the earlier plays.

The Third Period (1601-1608)

Shakespeare wrote his great tragedies during the third period of his artistic development. Except possibly for *Pericles*, every play of this period shows Shakespeare's awareness of the tragic side of life. Even the period's two comedies—*All's Well That Ends Well* and *Measure for Measure*—are more disturbing than amusing. For this reason, they are often called "problem" comedies or "bitter" comedies. *Pericles* represents Shakespeare's first *romance*—a drama that is generally serious in tone but with a happy ending.

During this period, Shakespeare's language shows remarkable variety and flexibility, moving easily back and forth between verse and prose. His language has become a totally dramatic tool that makes possible the skillful psychological portraits which mark this period.

Hamlet, a tragedy partly based on *Hamlet*, a lost play by an unknown English author, and on a story in *Histoires Tragiques*, a collection of tales by the French author François de Belleforest. Probably first performed in 1601. First published in 1603.

Prince Hamlet of Denmark deeply mourns the recent death of his father. He also resents his mother's remarriage to his uncle, Claudius, who has become king. The ghost of Hamlet's father appears to the prince and tells him he was murdered by Claudius. The ghost demands that Hamlet take revenge on the king.

Hamlet broods about whether he should believe the ghost. In his soliloquies, he criticizes himself for not acting against his uncle. He also considers the dangers and rewards of suicide. Hamlet decides to have a band of traveling actors perform "something like the murder

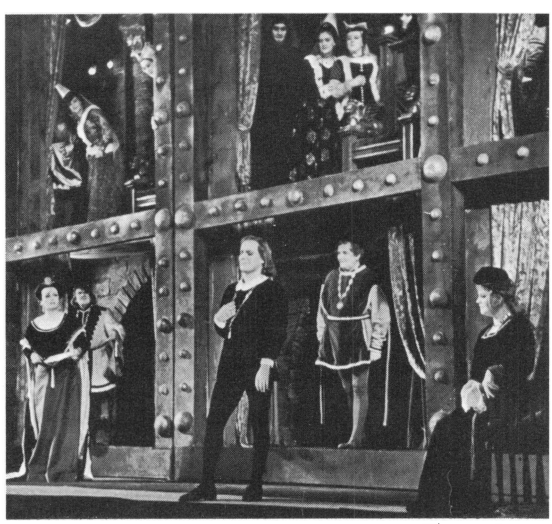
of my father" before the king to see if Claudius will show any guilt. The king's violent reaction to the play betrays his guilt. But Hamlet rejects a chance to kill Claudius while he is on his knees in prayer.

Polonius, the king's adviser, decides to eavesdrop on Hamlet while the prince is visiting his mother in her sitting room. He hides behind a curtain, but Hamlet becomes aware that someone is there. Hamlet stabs Polonius through the curtain and kills him.

Claudius exiles Hamlet to England for killing Polonius. He also sends secret orders that the prince be executed after he arrives in England. But Hamlet intercepts the orders and returns to Denmark. He arrives in time to see the burial of Ophelia, the daughter of Polonius. The girl, whom Hamlet had loved, had gone insane following her father's death and drowned herself.

Laertes, Ophelia's brother, blames Hamlet for the deaths of his sister and father. He agrees to a plot suggested by Claudius to kill Hamlet with a poisoned sword in a fencing match. Laertes wounds Hamlet during the duel and, in turn, is wounded himself by the poisoned weapon. While watching the match, Hamlet's mother accidentally drinks from a cup of poisoned wine Claudius had prepared for Hamlet. Although dying from his wound, Hamlet kills Claudius. At the end of the play, Hamlet, his mother, Claudius, and Laertes all lie dead.

Shakespeare handled the complicated plot of *Hamlet* brilliantly. In this play, he also created perhaps his greatest gallery of characters. The role of Hamlet in particular is considered one of the theater's greatest acting challenges. Shakespeare focused the play on the deep conflict within the thoughtful and idealistic Hamlet as he is torn between the demands of his emotions and the hesitant skepticism of his mind. Hamlet reveals this conflict in several famous and eloquent soliloquies. The best known is his soliloquy on suicide, which begins, "To be, or not to be."



Moscow Art Theater (Sovfoto)

Hamlet **is a tragedy about a sensitive young prince in Denmark who feels he must avenge his father's murder. This scene from a Russian production shows Hamlet, *center,* and his mother, Queen Gertrude, *left,* with other members of the Danish court.**

Troilus and Cressida, a tragedy based on several sources, none of which was a chief source. Probably first performed in 1602. First published in 1609.

The story takes place during the Trojan War, fought between ancient Greece and the city of Troy. It dramatizes the love of the Trojan warrior Troilus for the unfaithful Cressida. The couple pledge their love, but Cressida is unexpectedly sent to the Greek camp in exchange for a Trojan prisoner. There she abandons her vow to Troilus and takes the Greek warrior Diomedes as her lover. The play ends with the death of Troilus' brother, the great Trojan hero Hector.

In spite of its heroic setting, *Troilus and Cressida* is neither noble nor stirring. Except possibly for Hector, all the characters act less than heroically. In both outlook and style, the play has more in common with the problem comedies than with the great tragedies.

All's Well That Ends Well, a comedy partly based on a story in *The Palace of Pleasure*, a collection of tales by various European authors, as translated by William Painter, an Englishman. Probably first performed in 1603. First published in 1623.

This play takes place in France and Italy. Helena, the beautiful orphaned daughter of a physician, loves Bertram, a nobleman. In Paris, Helena cures the French king of an illness and wins Bertram as her husband in reward. But Bertram considers Helena beneath him socially and deserts her immediately after the wedding. He tells her in a letter that she can never call him husband unless she gets a ring from his finger and becomes pregnant by him. Helena fulfills both conditions. One night, unknown to Bertram, she takes the place of a girl for whom her husband has a foolish passion. Bertram finally recognizes his wife's good qualities and promises to love her dearly.

On the surface, *All's Well That Ends Well* resembles other Elizabethan comedies of romantic intrigue. But unlike Shakespeare's earlier comedies, it has little gaiety and romance. Bertram's conduct makes him an unattractive hero. Many critics also dislike Helena for throwing herself at him. The play's interest lies primarily in Shakespeare's efforts to express through comedy his troubled view of mankind's imperfections.

Measure for Measure, a comedy partly based on *Promos and Cassandra*, a play by the English author George Whetstone. Probably first performed in 1604. First published in 1623.

Vincentio, Duke of Vienna, turns over the affairs of the city to Angelo, his stern deputy, and Escalus, a wise old nobleman. The duke hopes the two men will introduce needed moral reforms in Vienna. In one of his first acts, Angelo sentences Claudio to death for making Juliet, his fiancée, pregnant. Claudio's sister, Isabella, pleads with Angelo for Claudio's life. Overcome by her beauty, Angelo agrees to save Claudio if she will allow him to make love to her. Isabella refuses, preferring to let her brother die rather than yield her honor. After much intrigue and plotting, Claudio is saved, Isabella keeps her virtue, and Angelo's wicked deeds are exposed.

Many critics have objected to the happy ending of *Measure for Measure*. They consider it false to the spirit of the play. The first part of the play is serious, almost tragic. The latter part becomes a typical romantic intrigue. This lack of artistic unity creates problems. The first part of the play, for example, seriously raises questions about the nature of justice. But these questions seem to be answered too lightly at the play's end.

In spite of its flaws, *Measure for Measure* has many excellent features. Shakespeare drew the characters of Angelo and Isabella with keen understanding. He also included much broad comedy that is highly effective. In addition, his dramatic poetry at times equals that of the best in his tragedies.

Othello, a tragedy partly based on a story in *Hecatommithi*, a collection of tales by the Italian author Cinthio. Probably first performed in 1604. First published in 1622.

Othello, a noble black *Moor* (North African), has spent his life as a soldier and become a general in the army of Venice, Italy. He marries Desdemona, a beautiful Venetian girl much younger than himself. Almost immediately after the marriage, Othello is ordered to Cyprus, where Desdemona joins him. Othello's villainous aide, Iago, hates the Moor. Iago decides to destroy Othello by persuading him that Desdemona has made love with Cassio, Othello's lieutenant.

Iago quickly convinces Othello that Desdemona has been unfaithful. He achieves his goal by taking advantage of Othello's insecurity over his color, age, and lack of sophistication. Constantly tormented by Iago, Othello murders Desdemona. After the Moor learns he has been tricked, he stabs himself and dies, describing himself as "one that loved not wisely, but too well."

This play is Shakespeare's most straightforward tragedy. The action moves rapidly, and the language is simple and direct, like the main character. *Othello* and *Romeo and Juliet* differ from Shakespeare's other tragedies in that neither deals with public affairs and royalty. Instead, *Othello* is a tragedy of personal tensions, of love and hatred, and of jealousy and impatience.

King Lear, a tragedy partly based on the *Chronicles* by the English historian Raphael Holinshed; *The True Chronicle History of King Leir*, a play by an unknown English author; and *Arcadia*, a romance in prose and verse by the English author Sir Philip Sidney. Probably first performed in 1605. First published in 1608.

The main plot concerns Lear, an aged king of ancient Britain. He prepares to divide his kingdom among his three daughters—Regan, Goneril, and Cordelia. Lear becomes angry when Cordelia, his youngest daughter, refuses to flatter him to gain her portion of the kingdom. Lear rashly disinherits her. He also exiles his trusted adviser, Kent, for supporting Cordelia.

Regan and Goneril soon show their ingratitude. They deprive Lear of his servants and finally force him to spend a night outdoors during a storm accompanied only by his jester, called the Fool. Lear's mind begins to snap under the strain. But as he approaches madness, he finally sees his errors and selfishness. Cordelia, who had been living in France, returns to Britain and finds the king insane. Lear recovers his sanity and recognizes her. Armies raised by the wicked sisters capture Lear and Cordelia, who is put to death. Meanwhile, Goneril has poisoned Regan in a bitter quarrel over a man they both love and then killed herself. Order is finally restored in the kingdom. But Lear dies of a broken heart as he kneels over the body of Cordelia.

Shakespeare skillfully wove a subplot into the main story of Lear and his daughters. Gloucester, a nobleman in Lear's court, makes the mistake of banishing his faithful son, Edgar, and trusting his wicked son, Edmund. Edmund soon betrays his father, who is blinded by Regan's husband. Edgar discovers his blind father and comforts him. Gloucester realizes his errors and especially his lack of concern for people less fortunate than himself. He then dies.

In *King Lear*, Shakespeare created the brilliant characterizations that mark his dramas at their best. The characters realize their mistakes, which reflects Shakespeare's basic optimism. But they do so too late to prevent their destruction and that of the people around them. This fact is at the heart of Shakespeare's tragic view of mankind.

Macbeth, a tragedy partly based on the *Chronicles* by the English historian Raphael Holinshed. Probably first performed in 1606. First published in 1623.

This play is set in Scotland. Returning from battle with his companion Banquo, the nobleman Macbeth meets some witches. They predict that Macbeth will first become *thane* (baron) of Cawdor and then king of Scotland. Macbeth privately has ambitions of becoming king. After the first part of the witches' prophecy comes true, he begins to think the second part may also come true. Encouraged by Lady Macbeth, his wife, Macbeth murders King Duncan, a guest in his castle. Macbeth then seizes the throne of Scotland.

But Macbeth has no peace. Duncan's sons have escaped to England, where they seek support against Macbeth. In addition, the witches had also predicted that Banquo's descendants would be kings of Scotland. Macbeth therefore orders the murder of Banquo and his son, Fleance. Macbeth's men kill Banquo, but Fleance escapes. Macbeth is now hardened to killing. He orders the murder of the wife and children of his enemy Macduff, who had fled to England after Duncan's murder. Macduff then gathers an army to overthrow Macbeth. By this time, Lady Macbeth, burdened with guilt over the murders, has become a sleepwalker. She finally dies. At the end of the play, Macduff kills Macbeth in battle. Duncan's son Malcolm is then proclaimed king of Scotland.

In *Macbeth*, Shakespeare wrote a tragedy of a man's conscience. During the course of the play, Macbeth changes from a person of strong but imperfect moral sense to a man who will stop at nothing to get and keep what he wants. By the play's end, Macbeth has lost all emotion. He cannot even react to his wife's death, except to conclude that life is only "a tale / Told by an idiot, full of sound and fury, / Signifying nothing." On the other hand, Lady Macbeth encourages murder in the beginning. But her conscience grows as her husband's lessens. In addition to its psychological insights, *Macbeth* has many passages of great poetry.

The play is also noted for its bitter humor, which reinforces the tragic action.

Timon of Athens, a tragedy partly based on *Lives* by the ancient Greek biographer Plutarch, as translated by the English writer Sir Thomas North. Probably first performed in 1607. First published in 1623.

Timon is a nobleman in ancient Athens. Surrounded by flatterers, he spends his money extravagantly. But after he becomes penniless, his friends desert him. Their ingratitude turns Timon into a bitter person who hates humanity. Timon leaves Athens and goes to live in a cave near the sea, where he finds a buried treasure. But his new-found wealth brings him no happiness. He dies, still a bitter man, in the cave.

Although *Timon of Athens* has flaws, it also has passages of great eloquence. Several such passages occur when Timon pours out his scorn for mankind. Throughout the play, Shakespeare portrays people at their worst, with few of the honorable qualities that lighten the gloom in his great tragedies.

Pericles, a romance partly based on a story in *Confessio Amantis*, a collection of European tales retold by the English poet John Gower. Probably first performed in 1607. First published in 1609.

The action in *Pericles* covers many years and ranges over much of the ancient Mediterranean world. The plot deals with the adventures of Prince Pericles of Tyre. It tells of his marriage, the apparent loss of his wife and daughter, and his rediscovery of them. The play is notable for the characters of the virtuous Pericles and his equally virtuous daughter, Marina. The most moving scene in *Pericles* comes near the end of the play, when Pericles and Marina meet and recognize each other after years of separation.

The play consists of many loosely related episodes and is uneven in quality. Scholars disagree over how much of *Pericles* Shakespeare actually wrote. But the majority believe he wrote most or all of it.

Antony and Cleopatra, a tragedy partly based on *Lives* by the ancient Greek biographer Plutarch, as translated by the English writer Sir Thomas North. Probably first performed in 1607. First published in 1623.

Mark Antony, together with Octavius and Lepidus, rules the Roman Empire. Antony lives in Roman-conquered Egypt, where he has taken the Egyptian queen, Cleopatra, as his mistress. Political problems in Rome and the death of his wife force Antony to leave his life of pleasure and return home. Back in Rome, he marries Octavius' sister Octavia for political reasons. But Antony soon returns to "his Egyptian dish." Octavius then prepares for war against him.

Antony decides unwisely to fight Octavius at sea. During the battle, Cleopatra's fleet deserts him, and Antony flees with the queen. After Cleopatra's ships desert him in a second battle, Antony finally realizes that he has lost everything. Cleopatra deceives him into thinking that she is dead, and Antony stabs himself. But before he dies, he learns that Cleopatra is still alive. Antony then returns to her and dies in her arms. Cleopatra dresses herself in her royal robes, presses a poisonous snake to her breast, and dies of its bite.

The dazzling poetry of *Antony and Cleopatra* is one of the tragedy's most notable features. Early in the play, Enobarbus, one of Antony's officers, gives a famous description of Cleopatra that begins, "The barge she sat in, like a burnished throne, / Burned on the water." Cleopatra is Shakespeare's finest female portrayal. At one moment she is playful, then sulking, and then filled with deadly anger. As Enobarbus says:

> Age cannot wither her, nor custom stale
> Her infinite variety. Other women cloy
> The appetites they feed, but she makes hungry
> Where most she satisfies. . . .

Shakespeare's dramatic use of poetry reveals Antony and Cleopatra from various points of view. On one level, they are merely two persons exhausted by a life of excessive pleasure and luxury. On another level, they are tragic characters willing to risk kingdoms for their love. Shakespeare laughs at them for their foolishness, sympathizes with them for their suffering, and admires them for their moments of personal nobility.

Coriolanus, a tragedy partly based on *Lives* by the ancient Greek biographer Plutarch, as translated by the English writer Sir Thomas North. Probably first performed in 1608. First published in 1623.

Caius Marcius, a general in ancient Rome, wins the name Coriolanus after he captures Corioli, the capital city of a people known as the Volscians. Coriolanus returns to Rome in triumph and is nominated for the important office of consul. But he cannot hide his scorn for the common people, whose support he needs to become consul. Coriolanus' superior attitude leads to his exile. He joins forces with his old enemy, the Volscian general Tullus Aufidius, and heads an army against Rome. Coriolanus' mother, wife, and young son meet him outside the city and beg him to spare it. Moved by their pleas, Coriolanus withdraws his troops. Aufidius denounces him as a traitor and has him murdered.

In *Coriolanus*, Shakespeare raised issues that remain particularly important today. The tragedy questions the values of personal popularity and political success. It also debates the conflicting interests of public and private life. Shakespeare's direct and dramatic verse contributes to the play's power.

The Fourth Period (1609-1613)

During his final period, Shakespeare wrote four plays —three comedies and a history. Most scholars label these three comedies and *Pericles* as his romances. Shakespeare probably wrote the history, *Henry VIII*, with John Fletcher.

The three romances are beautifully constructed, and their poetry ranks among Shakespeare's finest writing. But unlike his masterpieces of the third period, the romances seem detached from reality. Scholars disagree on the reason for this change in Shakespeare's works. Some claim he was calmly looking back on his life and philosophically summing up his career. Other scholars believe that Shakespeare wrote the romances to suit the changing tastes of his audience. They feel that these dramas reflect the growing popularity of plays that mixed comic and serious qualities. The romances probably represent both a change in Shakespeare's attitude toward life and an attempt to follow theatrical fashions.

Cymbeline, a romance partly based on several sources, none of which was a chief source. Probably first performed in 1609. First published in 1623.

Cymbeline, king of Britain, angrily exiles the poor but honorable Posthumous after the young man marries Imogen, the king's daughter. The treacherous Iachimo bets Posthumous that Imogen is not virtuous. Iachimo then tries to make love to her. He fails but tricks Posthumous into believing that Imogen let him do so. Posthumous orders his wife killed, but she escapes disguised as a court page. After many adventures, Imogen and her husband are happily reunited. Iachimo, filled with regret, confesses his wickedness.

The characters in *Cymbeline* are expertly drawn. Imogen in particular is one of Shakespeare's most appealing heroines. The play also has a lively, melodramatic plot. The plot moves close to tragedy but never quite touches the tragic level.

The Winter's Tale, a romance partly based on *Pandosto,* a prose romance by the English author Robert Greene. Probably first performed in 1610. First published in 1623.

Leontes, king of Sicilia, becomes uncontrollably jealous of his faithful wife, Hermione. He has her imprisoned and orders that their newborn daughter, Perdita, be abandoned in some isolated place. Leontes finally realizes that he has no cause for jealousy. But his conduct has cost him his friends and family, including his wife, who had fallen into a deathlike faint.

Meanwhile, Perdita has been saved by an old shepherd. She grows into a lovely young girl and wins the love of Florizel, prince of Bohemia. But Florizel's father angrily disapproves of their romance, and the couple flee to Leontes' court for protection. There, Leontes discovers that Perdita is his daughter. The king's happiness is complete when he is also reunited with his wife, whom he thought was dead. She had actually been living alone while hoping for the return of Perdita.

Like *Cymbeline*, *The Winter's Tale* concerns exile, women suffering from male jealousy, and the reuniting of loved ones. Also like the earlier play, this drama takes a potentially tragic situation and uses it to stress rebuilding rather than destruction. The characters, made wiser by their sad experiences, happily face the future.

The Tempest, a romance partly based on several sources, none of which was a chief source. Probably first performed in 1611. First published in 1623.

Prospero, the wrongfully exiled Duke of Milan, Italy, lives on an enchanted island with his beautiful daughter, Miranda. The mischievous spirit Ariel and the monster Caliban serve Prospero, who is a skilled magician. Using magic, Prospero creates a *tempest* (storm) that causes a ship carrying his enemies to be wrecked on the island. The ship also carries the young prince Ferdinand. Miranda loves him at first sight and cries out, "O brave new world that hath such creatures in it." With his magic, Prospero brings Miranda and Ferdinand together and upsets various plots laid against him by his shipwrecked enemies. Prospero finally appears before his enemies and forgives them. He decides to give up his magic and return to Italy, where Ferdinand and Miranda can be married.

American Shakespeare Theatre, Stratford, Conn. (Martha Swope)

The Tempest was Shakespeare's last great comedy. The play takes place on an enchanted island ruled by Prospero, a magician, *center.* Prospero lives on the island with his daughter, Miranda, *right,* and his unwilling slave, the savage monster Caliban, *left.*

Like *Cymbeline* and *The Winter's Tale*, *The Tempest* tells a story in which old injuries are forgiven and the characters begin a new and happier life. In *The Tempest*, Shakespeare blended spectacle, song, and dance with a romantic love story, beautiful poetry, and broad comedy. The result is a brilliant dramatic fantasy. The play also has one of Shakespeare's most famous speeches. In this speech, Prospero tells the audience:

> Our revels now are ended. These our actors,
> As I foretold you, were all spirits and
> Are melted into air, into thin air;
> And, like the baseless fabric of this vision,
> The cloud-capped tow'rs, the gorgeous palaces,
> The solemn temples, the great globe itself,
> Yea all which it inherit, shall dissolve,
> And, like this insubstantial pageant faded,
> Leave not a rack behind.

For generations, many scholars have taken these lines to be Shakespeare's farewell to his profession. But experts do not really know if Shakespeare intended the speech to be autobiographical.

Henry VIII, a history partly based on the *Chronicles* by the English historian Raphael Holinshed and on *The Book of Martyrs*, a religious work by the English author John Foxe. Probably first performed in 1613. First published in 1623.

The play dramatizes the events that led to England's break with the Roman Catholic Church. It deals with King Henry VIII's divorce of Katherine of Aragon and his marriage to Anne Boleyn. The play also covers the fall of Cardinal Wolsey as the king's adviser and the rise of Archbishop Cranmer as Wolsey's replacement. *Henry VIII* is a loosely constructed drama and better known for its pageantry than for its characterization. Although the play does have passages of splendid verse, the work as a whole does not show Shakespeare at the height of his creative powers.

Shakespeare wrote two long poems, *Venus and Adonis* and *The Rape of Lucrece*. Both are *narrative* poems—that is, they tell a story. Shakespeare also composed a sequence of 154 sonnets and a short poem called "The Phoenix and the Turtle."

The Narrative Poems

Venus and Adonis (1593) is partly based on the *Metamorphoses*, a collection of tales in verse by the ancient Roman poet Ovid. The poem tells how Venus, the goddess of love, tries to win the love of the handsome young mortal Adonis. He resists her and is finally killed by a wild boar while hunting.

Shakespeare wrote *Venus and Adonis* in six-line stanzas. Most of the lines have five accented syllables. The lines of *Venus and Adonis* rhyme *ababcc*, which means the first and third lines rhyme, as do the second and fourth, and the fifth and sixth.

The poem is witty and filled with sexual references. But the work is most notable for its vivid settings and its formal and elaborate speeches. *Venus and Adonis* represents Shakespeare's successful attempt to write the kind of love poetry that was popular among literary members of the royal court.

The Rape of Lucrece (1594) is also partly based on the works of Ovid, as well as on writings by other authors. The poem tells of Lucrece, the virtuous wife of a Roman nobleman. She is sexually attacked by the lustful general Tarquin. After the rape, Lucrece demands that her husband and his friends swear to revenge her ruined honor. She then kills herself.

Shakespeare wrote *The Rape of Lucrece* in seven-line stanzas, each line having five accents. The lines rhyme *ababbcc*. The poem is more serious in tone than *Venus and Adonis*. The work has little action and, like the earlier poem, depends greatly on long flowery speeches for its effect.

The Sonnets

In the late 1500's, it was fashionable for English gentlemen authors to write sequences of sonnets. Some sonnet sequences followed a narrative pattern that was autobiographical in varying degrees. For this reason, scholars have tried to learn about Shakespeare's life from his sonnets. But they have reached no general agreement on autobiographical information that the poems might contain.

Scholars generally do agree, however, that Shakespeare addressed the first 126 sonnets to a young nobleman and that the next 26 concentrate on a woman. But they have not been able to identify either person. They have long debated over the nature of Shakespeare's relationship with the young man and have come to no general conclusion. Many scholars believe that Shakespeare had a passionate but somewhat reluctant love affair with the woman. Because the poems describe the woman as a brunette, she has become known as the "dark lady" of the sonnets. Sonnets 153 and 154 seem unrelated to the others, and some scholars doubt that Shakespeare wrote them.

Composition and Publication. Shakespeare probably wrote the sonnets over a period of several years, though the dates are unclear. He wrote the poems in three units of four lines each and a concluding *couplet* (two-line unit). The sonnets rhyme *abab cdcd efef gg*.

Two of the sonnets originally appeared in a book of poetry called *The Passionate Pilgrim* (1599). Thomas Thorpe published the sonnets as a collection in 1609. Thorpe dedicated the book to Mr. W. H., whom he called "the only begetter of these ensuing sonnets." Scholars do not know who Mr. W. H. was or even if he inspired the poems or merely collected them for the publisher. The individual poems have no titles. Scholars refer to them either by their first line or by the number Thorpe assigned to them.

Themes. In the sonnets addressed to his aristocratic friend, Shakespeare treated a variety of subjects. "Shall I compare thee to a summer's day?" (sonnet 18) praises physical beauty. "When, in disgrace with Fortune and men's eyes" (sonnet 29) describes the power of friendship to cheer the poet. Some of the sonnets are particularly notable for their wit, as in "That time of year thou mayst in me behold" (sonnet 73).

In several of the first 126 sonnets, Shakespeare referred to another poet he considered a rival for his young friend's affection and support. Scholars have called this person the "rival poet." They do not know who he was or if he even existed.

The sonnets' most common themes concern the destructive effects of time, the quickness of physical decay, and the loss of beauty, vigor, and love. Although the poems celebrate life, it is always with a keen awareness of death. This awareness of death is perhaps best expressed in "Poor soul, the center of my sinful earth" (sonnet 146).

A distrust of love and human nature runs through the "dark lady" sonnets. Sonnet 138, which follows, reflects this attitude. The poem is also representative of the entire sequence in two ways. The sonnet tells of the poet's concern over the passing of time, and it shows his strong emotion controlled by his highly intellectual wit.

When my love swears that she is made of truth
I do believe her, though I know she lies,
That she might think me some untutored youth,
Unlearned in the world's false subtleties.
Thus vainly thinking that she thinks me young,
Although she knows my days are past the best,
Simply I credit her false-speaking tongue:
On both sides thus is simple truth suppressed.
But wherefore says she not she is unjust?
And wherefore say not I that I am old?
O, love's best habit is in seeming trust,
And age in love loves not to have years told.
Therefore I lie with her and she with me,
And in our faults by lies we flattered be.

"The Phoenix and the Turtle"

This 67-line poem appeared in 1601 in a collection called *Love's Martyr*. It praises ideal love, using as symbols two birds, the phoenix and the turtledove. The poem has philosophical and symbolic qualities that have led to various biographical, political, and religious interpretations by critics.

Shakespeare and other Elizabethan writers looked upon the English language as alive and changing. They did not consider it fixed for all time in a set of correct and unbreakable rules. Shakespeare experimented freely with sentence structure and vocabulary to create special effects. He also used various literary devices to present information and ideas in a dramatic and appealing way. But Shakespeare's style is perhaps best known for its brilliant use of language to create vivid pictures in the mind.

Shakespeare's style has helped shape the language of all English-speaking countries. This influence has chiefly been felt directly through his writings. But it has also been felt through the interest his work has aroused in the literature of the Elizabethan period in general. Many later writers in English have accepted the Elizabethan style as their model. As a result, much English and American literature reflects the highly individualized enthusiasm of most Elizabethan writing.

Vocabulary. Shakespeare changed words, invented words, and borrowed words from other languages. He even used nouns as verbs for dramatic effect. In *Measure for Measure*, for example, a character remarks that Angelo "dukes it well," referring to the forceful way in which Angelo handles the duties of the absent Duke of Vienna. Shakespeare also used verbs in both their modern form—for example, *has*—and their older form—*hath*. In the same way, he used both modern pronouns, such as *you*, and older pronouns, such as *thee* or *thou*.

Some of Shakespeare's words may be unfamiliar or confusing to modern readers and theatergoers. His vocabulary basically resembles modern English, but he employed many words that are no longer used. Readers and theatergoers may also be puzzled by familiar words that had additional or different meanings in Shakespeare's time. In *Othello*, for example, Iago raises a "shrewd doubt" about Desdemona's faithfulness. In this case, "shrewd" means "serious" or "grave," not its modern meaning, "clever." Most editions of Shakespeare's plays include notes that define such words.

Rhetoric. Shakespeare and other Elizabethan writers enjoyed using *rhetoric*—special literary devices that present a fact or idea in a dramatic and interesting way. Indeed, authors were often more concerned with how something was said than with what was said.

Shakespeare used many kinds of rhetorical devices that writers still use. One familiar kind is *alliteration*, in which the same sound is repeated in a line or group of lines of verse. When Juliet tells Romeo that "parting is such sweet sorrow," the *s* sounds of the last three words provide alliteration. Shakespeare also frequently used a rhetorical device called *repetition*. Hamlet's cry against his stepfather "O villain, villain, smiling, damned villain!" shows effective dramatic use of repetition.

Shakespeare's rhetoric became more skillful as he matured as a playwright. In his early play *Richard III*, for example, much of the repetition is artificial and awkward. But in his later plays, Shakespeare used repetition naturally and effectively. An example can be shown from *Othello*. The Moor, carrying a candle, sees his sleeping wife and prepares to murder her. He utters the simple and moving sentence "Put out the light, and then put out the light." He then proceeds to debate the finality of death before he smothers his wife. This rhetorical device is called *antanaclasis*, which means the repetition of a word or phrase but with a deliberate shift in meaning.

Like other poets, Shakespeare often used *metaphor*—a figure of speech in which two different things are compared. In *As You Like It*, for example, Jaques begins a famous soliloquy with a metaphor:

> All the world's a stage,
> And all the men and women merely players.
> They have their exits and their entrances,
> And one man in his time plays many parts,
> His acts being seven ages.

Shakespeare enjoyed using *puns* (humorous plays on words). In *Cymbeline*, he wrote, "Golden lads and girls all must, / As chimney-sweepers, come to dust." The lines express the serious thought that even beautiful young people must grow old and die, but the pun adds a light touch. In *Henry V*, Pistol, an English soldier fighting in France, says, "To England will I steal, and there I'll steal."

Imagery. The richness and precision of Shakespeare's imagery give his writing its unique style. A famous example of his brilliant imagery comes from *Macbeth*. Horrified by his murder of King Duncan, Macbeth looks at his bloodstained hands and says:

> What hands are here? Ha! They pluck out mine eyes!
> Will all great Neptune's ocean wash this blood
> Clean from my hand? No. This my hand will rather
> The multitudinous seas incarnadine,
> Making the green one red.

The image of Duncan's blood turning all the oceans *incarnadine* (blood-red) reveals the terrifying sorrow Macbeth feels over committing the murder.

Another vivid example of Shakespeare's imagery appears in *Richard II*. Richard warns Bolingbroke that his rebellion against the king will bring the horrors of civil war to England:

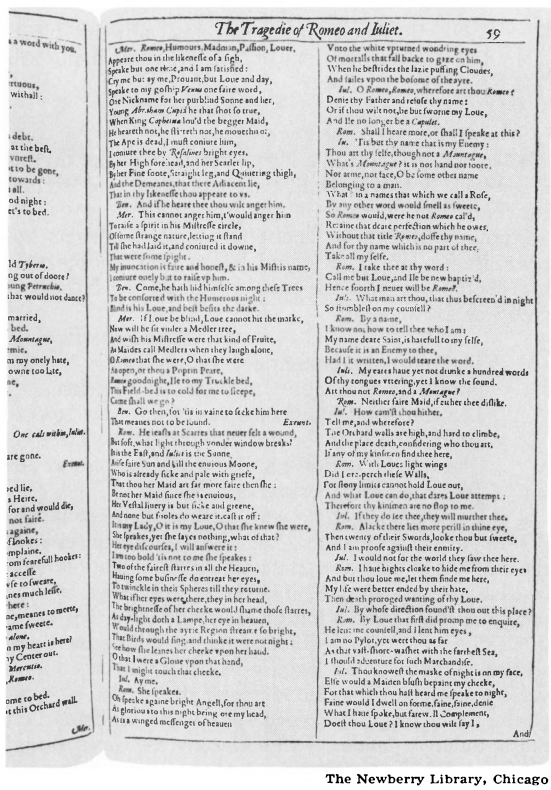
> He is come to open
> The purple testament of bleeding war.
> But ere the crown he looks for live in peace,
> Ten thousand bloody crowns of mothers' sons
> Shall ill become the flower of England's face,
> Change the complexion of her maid-pale peace
> To scarlet indignation, and bedew
> Her pastures' grass with faithful English blood.

Verse Form. Shakespeare reinforced his imagery with the rhythm of his verse. He composed his plays largely in blank verse—that is, in lines of unrhymed iambic pentameter. In such a pattern, each line is divided into five units called *feet*, with the accent falling on every second syllable. Of all English metrical patterns, blank verse—particularly when occasionally varied—comes closest to the rhythms of everyday speech. In his earliest plays, much of Shakespeare's blank verse was stiff and artificial. But it soon developed into a completely flexible dramatic instrument. Through his verse, Shakespeare could create a feeling of speed and excitement or a sense of calm dignity.

No manuscripts of Shakespeare's plays exist. As a result, modern editions of the plays must be based on early published texts. There are two kinds of these texts, *quartos* and *folios*. A quarto is a small volume containing one Shakespeare play. A folio is a large volume of his collected plays. Nineteen of Shakespeare's plays first appeared in quarto form. For his remaining 18 plays, a folio is the only source.

The publishing history of Shakespeare's plays has been a story of constant attempts by editors to correct errors in the quartos and folios. Editors have also tried to explain difficult words and phrases in the light of new historical information.

Quartos have been classified as *good quartos* and *bad*, or *pirated*, *quartos*. The good quartos were probably printed either from Shakespeare's own manuscripts or from reasonably accurate copies of them. Generally, the good quartos provide a clear and readable text, though Elizabethan printing was careless by modern standards. The bad quartos are shortened versions of the plays. They differ sharply from folio and good quarto texts. The bad quartos have so many errors that in places they are almost meaningless. These quartos were published without permission from Shakespeare's company. Scholars generally agree that the texts were reconstructed from memory by one or more actors who had appeared in the plays.



The Newberry Library, Chicago

The First Folio was the earliest edition of Shakespeare's collected plays. The book was published in London in 1623. A page from the tragedy *Romeo and Juliet* is reproduced above.

Folios. The first edition of Shakespeare's collected plays is called the *First Folio*. Isaac Jaggard, a printer, and Edward Blount, a bookseller, published the volume in 1623, seven years after Shakespeare died. The book contains all Shakespeare's accepted plays except *Pericles*. John Heminge and Henry Condell, former members of Shakespeare's company, assembled the plays. In the introduction, they wrote that the plays were "absolute in their numbers, as he [Shakespeare] conceived them." Although the First Folio does not quite live up to this statement, it remains an outstanding publishing achievement for its time.

Heminge and Condell obtained the texts of the plays from various sources, including quartos and playhouse *promptbooks*. A promptbook was a copy of the script with detailed directions for performing the play. The First Folio was followed by the Second Folio (1632), the Third Folio (1663-1664), and the Fourth Folio (1685). The final three folios show attempts at editorial corrections, but they are not considered dependable texts.

Editions of the 1700's and 1800's. During the 1700's, several English editors worked to produce better texts of Shakespeare's plays. Nicholas Rowe made the first important attempt with a multivolume edition published in 1709. Other notable editors of the 1700's, with the year in which their edition appeared, included Alexander Pope (1725), Lewis Theobald (1733), Samuel Johnson (1765), Edward Capell (1768), and Edmund Malone (1790). Theobald's edition is particularly important for its many corrections that try to restore the text to its original meaning. Johnson's edition is significant for its scholarly comments on the plays themselves.

The first *variorum* editions of the plays appeared during the 1800's. Variorum editions include notes by previous editors as well as alternate versions of disputed passages. The most elaborate edition is the *New Variorum* edited by H. H. Furness and others. The first volume was published in 1871. The project is still in progress, with almost 30 volumes published so far.

In the 1800's, the most important edition of the plays probably was the nine-volume *Cambridge Shakespeare* (1863-1866) edited by W. G. Clark, J. Glover, and W. Aldis Wright. In 1864, the edition was published in a single volume. Known as *The Globe Shakespeare*, it became the standard work for scholarly reference.

Modern Editions. Shakespearean editors of the 1900's have made two significant contributions to modern understanding of the plays. First, their editions show an increased awareness of the social and intellectual background against which Shakespeare worked. Second, modern editors have been able to interpret difficult passages and resolve textual problems with more confidence than earlier editors could. This confidence has resulted from new knowledge gained about printing and publishing during the Elizabethan Age.

Modern multivolume scholarly editions include the *New Cambridge Shakespeare* (1921-1966) and the *New Arden Shakespeare* (1951-). Several single-volume editions also provide dependable texts and helpful comments. They include those edited by George Lyman Kittredge (1936), *The Complete Pelican Shakespeare* (1969), and *The Riverside Shakespeare* (1974).

Shakespearean criticism—that is, serious analysis of Shakespeare and his works—did not begin until the late 1600's. During Shakespeare's lifetime, Robert Greene apparently attacked Shakespeare for thinking he could write as well as university-educated playwrights. Francis Meres considered Shakespeare the best English stage dramatist for comedy and tragedy. The First Folio, which appeared in 1623 after Shakespeare's death, contained a number of poems praising Shakespeare. The poems included a famous tribute by the playwright Ben Jonson. Jonson said of Shakespeare, "He was not of an age, but for all time!" But all these comments cannot be considered formal criticism.

Neoclassical Criticism. Scholars have traditionally called the period of English literature from 1660 to 1798 the neoclassical period. During this period, drama criticism was heavily influenced by the theories of the ancient Greek philosopher Aristotle. Neoclassical critics believed that Aristotle had established certain rules for writing drama. Many of these critics were bothered by Shakespeare's failure to follow these rules. For example, Shakespeare often broke the neoclassical rule against mixing comedy with tragedy. Most critics concluded, however, that Shakespeare was unaware of Aristotle's theories and so could be excused for ignoring them.

A landmark of neoclassical criticism of Shakespeare appeared in John Dryden's *An Essay of Dramatic Poesy* (1668). This work is usually considered the first serious criticism of the dramatist. In the essay, Dryden compared Shakespeare with Ben Jonson. Dryden wrote that he admired Jonson for being "the more correct poet." However, he loved Shakespeare, who "needed not the spectacles of books to read Nature" but "looked inwards, and found her there."

The most sensible neoclassical criticism came from the writer Samuel Johnson. He praised Shakespeare for holding up a "faithful mirror of manners and of life." He also recognized the universal appeal of Shakespeare's plays. At the same time, Johnson criticized what he considered to be Shakespeare's weaknesses. For example, Johnson objected to many comic sexual passages, which he considered vulgar.

In his influential *An Essay on the Dramatic Character of Sir John Falstaff* (1777), Maurice Morgann tried to show that Falstaff was not really a coward, as other critics claimed. Morgann analyzed the comic figure in great detail, as if Falstaff were a real person. Many later critics also came to regard Shakespeare's major characters as actual people independent of the plays.

Romantic Criticism. A movement called romanticism began to influence English literature significantly about 1798. Its influence lasted through most of the 1800's. The romantic critics tended to glorify Shakespeare almost as a god who could do no wrong. Some romantic critics believed that Shakespeare's plays should properly be studied as nondramatic literature and not simply as works for the stage.

In spite of their one-sided view of Shakespeare's genius, the romantics produced many outstanding works of criticism. These works included Charles Lamb's *On the Tragedies of Shakespeare* (1811) and William Hazlitt's *Characters of Shakespeare's Plays* (1817). The lectures and essays of Samuel Taylor Coleridge also rank as landmarks of Shakespearean criticism.

Romantic criticism reached a climax with two books. The first was Edward Dowden's *Shakspere: A Critical Study of His Mind and Art* (1875). The book attempts to relate the moral problems posed in the plays to Shakespeare's own experience with those problems. The second influential book was A. C. Bradley's *Shakespearean Tragedy* (1904). Bradley examined *Hamlet*, *Othello*, *King Lear*, and *Macbeth* and tried to show that the major characters behave in a psychologically true way.

Modern Criticism. Critics in the 1900's have profited greatly from modern scholarship in all areas of Shakespeare's life, times, and writings. The following discussion deals with some of the major contributions that British and American scholars have made to modern Shakespearean criticism.

Many scholars have concentrated on the study of Shakespeare's early texts to bring critics closer to what the playwright actually wrote. The leading textual scholars of the early 1900's include W. W. Greg, R. B. McKerrow, A. W. Pollard, and J. Dover Wilson.

Modern scholars have also explored the conditions under which Shakespeare's plays were first produced. They have done research on the theater buildings, the actors, and the audiences. Joseph Quincy Adams' *Shakespearean Playhouses* (1917) and E. K. Chambers' four-volume *The Elizabethan Stage* (1923) provided the basis for many later studies. The most important of these studies include Alfred Harbage's *Shakespeare's Audience* (1941) and John Cranford Adams' *The Globe Playhouse* (1942). However, many of Adams' conclusions have been challenged by later scholars.

The scholarship of the 1900's has resulted in a variety of critical approaches to Shakespeare's plays. E. E. Stoll studied the plays in terms of Elizabethan theatrical traditions. Lily Bess Campbell, Hardin Craig, Theodore Spencer, and E. M. W. Tillyard analyzed the plays in the light of Elizabethan ideas on history, philosophy, and psychology. Harley Granville-Barker wrote a series of essays called *Prefaces to Shakespeare* (1927-1947). In these essays, Granville-Barker examined the plays as works for the stage and rejected the romantic belief that the plays should be studied rather than performed.

In the 1930's, critics began to show strong interest in Shakespeare's imagery. In *Shakespeare's Imagery and What It Tells Us* (1935), Caroline Spurgeon attempted to discover Shakespeare's beliefs and his likes and dislikes through his imagery.

Some modern critics have used psychological theory to try to penetrate the surface of the action and understand the subconscious motives of both the characters and the author. Ernest Jones, a psychoanalyst, took this approach in *Hamlet and Oedipus* (1949). Jones's book helped shape many interpretations of the plays on the modern stage and in motion-picture versions.

Jan Kott, a Polish critic, wrote an unusual study of the plays called *Shakespeare Our Contemporary* (1964). In this work, he tried to approach Shakespeare's plays from the pessimistic point of view of much literature of the mid-1900's.

Mrs. Siddons and J. P. Kemble in the Dagger Scene from Macbeth (1806), an oil painting on canvas by Thomas Beach; Garrick Club, London

Sarah Siddons was England's leading Shakespearean actress of the late 1700's and early 1800's. She often performed with her brother John Philip Kemble in *Macbeth*, above.

Shakespeare's own acting company gave the first performances of his plays. The company had a number of talented actors, including Robert Armin, Richard Burbage, Will Kempe, John Lowin, and Joseph Taylor. Burbage ranks as the first great Shakespearean tragic actor. Shakespeare, in fact, created most of his great tragic roles for him.

The Restoration Period. In 1642, civil war broke out in England, and Parliament closed the theaters. The Puritans, a stern religious and political group, gained control of the government and kept the theaters closed. In 1649, the Puritans beheaded the king, and England became a republic. But the people disliked Puritan rule, and Parliament restored the monarchy in 1660 under Charles II. This period in English history is called the Restoration. Charles reopened the theaters, and productions of Shakespeare and other playwrights resumed.

During the Restoration period, changes occurred in the production of plays. For example, painted scenery became popular, and women replaced boys in female roles. At the same time, dramatists thought that Shakespeare's plays needed to be "improved." For example, Sir Thomas Davenant, with John Dryden's help, added characters to *The Tempest*, and Nahum Tate gave the tragedy *King Lear* a happy ending. Colley Cibber cut the text of *Richard III* severely and added material from Shakespeare's other histories. Many such altered versions remained popular for years.

Although Restoration dramatists lacked respect for Shakespeare's texts, the period produced one of history's greatest Shakespearean actors, Thomas Betterton. Betterton was particularly noted for his interpretations of Hamlet, Macbeth, and Othello.

The Age of Garrick. The death of Betterton in 1710 marked the end of the Restoration era in English acting. A new era began in 1741 with the first appearance of David Garrick on the English stage. Garrick became the most celebrated actor of his time and the first English actor to be accepted into upper-class society. He won fame for his natural but forceful style of acting and excelled in many roles, especially Hamlet and Richard III. In spite of his devotion to Shakespeare, Garrick acted in versions of the plays that differed greatly from the original texts.

Another famous Shakespearean actor of the 1700's was John Philip Kemble, who made his London debut in 1783. He became noted for his controlled, intellectual style. But Kemble was overshadowed by his sister Sarah Siddons, generally considered history's greatest Shakespearean actress. She was a passionate yet controlled performer. Her Queen Katherine in *Henry VIII* and Lady Macbeth especially impressed audiences.

The 1800's. The first great Shakespearean actor to make his debut in the 1800's was the English actor Edmund Kean. An intense, unconventional, and romantic performer, he introduced a more passionate style of acting. According to one critic, Kean's acting was like reading Shakespeare by "flashes of lightning." Kean's greatest roles were Othello and Richard III.

William Charles Macready, an English actor and theater manager, fought to restore Shakespeare's texts to their original form. Unlike most of the actors who preceded him, Macready had a fundamental respect for Shakespeare's abilities as a playwright. In 1838, he produced a *King Lear* that restored an essentially Shakespearean text to the stage for the first time since the 1600's. Macready also rejected Davenant and Dryden's adaptation of *The Tempest* in favor of Shakespeare's original text.

Sir Henry Irving dominated Shakespearean production in the late 1800's. Irving was the leading English actor of his day. He also became famous for his elaborate productions of Shakespeare's plays. Audiences of his time found it difficult to visualize any other actor as

Bettmann Archive

Brown Bros.

Great Shakespearean Actors of the 1800's included Sir Henry Irving of England and Edwin Booth of the United States. Irving was famous for his role as Shylock in *The Merchant of Venice*, *left*. Booth often played the evil Iago in *Othello*, *right*.

Pictorial Parade

Laurence Olivier, *foreground,* became one of the greatest Shakespearean actors of the 1900's. In addition to his stage performances, the British actor directed and starred in motion-picture versions of *Henry V, Hamlet,* and *Richard III.* This scene from *Richard III* shows Olivier as the newly crowned Richard beside his queen, Lady Anne, played by Claire Bloom. Sir Ralph Richardson, *far right,* played the Duke of Buckingham.

Hamlet or Shylock. Irving's leading lady, Ellen Terry, also became immensely popular.

Important American Shakespearean actors began to appear in the early 1800's. The first great American Shakespearean actor was Edwin Forrest. Charlotte Cushman became the leading American Shakespearean actress of the 1800's. In the late 1800's, critics considered Edwin Booth to be the finest American actor, and some thought his Hamlet unequaled.

Modern Performances. In England during the early 1900's, Sir Herbert Beerbohm Tree continued Henry Irving's practice of staging spectacular productions of Shakespeare. But new ideas were revolutionizing the presentation of Shakespeare's plays. As early as the 1880's, the English actor and producer William Poel had begun a movement to simplify Shakespearean productions. He staged the plays as Shakespeare wrote them and also tried to recreate the conditions of Elizabethan productions. Lilian Baylis, an English theater manager, established a permanent Shakespearean acting company at the Old Vic Theatre in London in 1914. The Old Vic served as the world's leading Shakespearean company until it was absorbed in 1963 into the new National Theatre Company.

In the 1900's, the English theater has produced many outstanding Shakespearean performers. Leading actors include Richard Burton, Maurice Evans, Sir John Gielgud, Laurence Olivier, Sir Michael Redgrave, Sir Ralph Richardson, and Paul Scofield. Important Shakespearean actresses include Dame Peggy Ashcroft, Claire Bloom, Dame Edith Evans, and Vanessa Redgrave. The American theater has also produced a number of famous Shakespearean performers in the 1900's. They include John Barrymore, Katharine Cornell, Walter Hampden, and Orson Welles. Noted Canadian Shakespearean performers include Christopher Plummer, Douglas Rain, and Kate Reid.

Many motion pictures have been made of Shakespeare's plays. The most notable include Olivier's versions of *Henry V* (1944), *Hamlet* (1948), and *Richard III* (1956) and the Italian director Franco Zeffirelli's production of *Romeo and Juliet* (1968).

Today, a number of theater organizations present Shakespeare's plays regularly. In England, the Royal Shakespeare Company performs in London and Stratford-upon-Avon. In Canada, a Shakespearean festival is held each year in Stratford, Ont. Summer seasons of Shakespeare are presented in the United States in Stratford, Conn.; San Diego, Calif.; Ashland, Ore.; and New York City.

FRANK W. WADSWORTH

SHAKESPEARE, WILLIAM / *Study Aids*

Related Articles in WORLD BOOK include:

DIRECTORS AND PERFORMERS

Anderson, Dame Judith
Barrymore (family)
Bernhardt, Sarah
Booth (family)
Campbell, Mrs. Patrick
Cornell, Katharine
Cushman, Charlotte
Evans, Maurice
Forrest, Edwin
Garrick, David
Gielgud, Sir John
Granville-Barker, Harley
Guthrie, Sir Tyrone
Hampden, Walter
Irving, Sir Henry
Kean (family)
Mansfield, Richard
Olivier, Laurence
Reinhardt, Max
Robeson, Paul
Siddons, Sarah Kemble
Terry, Ellen Alicia
Webster, Margaret
Welles, Orson

OTHER RELATED ARTICLES

Blank Verse
Canada (picture: Theater)
Connecticut (Annual Events; picture)

Denmark (picture: The East-Central Hills)
Drama (Elizabethan and Stuart Drama)
Elizabeth I
English Literature (Elizabethan Drama)
Falstaff, Sir John
Folger Shakespeare Library
Globe Theatre
Hathaway, Anne
Holinshed's Chronicles
Macbeth
Motion Picture (The Importance of Motion Pictures [picture])
Ontario (Annual Events)
Oregon (Annual Events; picture)
Poetry (What Makes a Poem Great?)
Stratford-upon-Avon
Theater (picture: Theater in Canada)

Outline

I. Shakespeare's Life
- A. His Life in Stratford
- B. Early Career in London
- C. The Years of Fame
- D. His Last Years
- E. The Anti-Stratfordians

II. England of Shakespeare's Day
- A. Shakespeare's London
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III. The Elizabethan Theater
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VI. Shakespeare's Style
- A. Vocabulary
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VII. Publishing History
- A. Quartos
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VIII. Shakespearean Criticism
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- C. Modern Criticism

IX. Performances of the Plays
- A. The Restoration Period
- B. The Age of Garrick
- C. The 1800's
- D. Modern Performances

Questions

Why are *Measure for Measure* and *All's Well That Ends Well* called *problem comedies?*

How has Shakespeare influenced the English language?

What are the most common themes of Shakespeare's sonnets?

How did public and private theaters differ in Shakespeare's day?

Why has there been any question about the authorship of Shakespeare's plays?

What part did the Wars of the Roses play in Shakespeare's histories?

What attitude did the romantic critics have toward Shakespeare and his plays?

Into what three groups are Shakespeare's plays traditionally divided? What is an example from each group?

Why did Shakespeare turn to writing narrative poetry in the early 1590's?

Who was Richard Burbage? David Garrick? Sarah Siddons?

Reading and Study Guide

See *Shakespeare, William,* in the RESEARCH GUIDE/INDEX, Volume 22, for a *Reading and Study Guide.*

Books to Read

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SHAKESPEARE GARDEN is any garden designed to include the features of gardens in Shakespeare's time. All the outdoor plants mentioned in his plays and poetry grow in such a garden. Many public parks, such as Central Park in New York City and Golden Gate Park in San Francisco, have Shakespeare gardens.

SHAKING PALSY. See PARKINSON'S DISEASE.

SHALE, *shayl*, is a sedimentary rock found in layers, often with layers of sandstone or limestone. It is formed from clay under heat and pressure. It is easily broken. When a slab is broken off, the split lies roughly parallel to the layer. Heat and pressure change shale to slate.

Like clay, shale is ground up to use in manufacturing bricks and portland cement. Bituminous shale is rich in petroleum and related substances. It burns with a flame, and the petroleum can be extracted. WALTER H. BUCHER

See also OIL SHALE; PETROLEUM (Oil Shale); SLATE.

SHALIMAR GARDENS cover about 80 acres (32 hectares) near Lahore, Pakistan. They were laid out in 1637 by order of Shah Jahan for the enjoyment of his court and the royal family and have become famous for their beauty (see SHAH JAHAN). A wall surrounds the lawns and flower beds. Huge, ancient trees shade much of the area. The gardens consist of three parts, laid out on different levels. Pavilions stand at the four corners of the area. About 100 fountains spout in the garden, and 200 in the pool in its center.

SHALLENBERGER, OLIVER B. See ELECTRIC METER.

SHALLOT is a plant similar to the onion. It is smaller than the onion plant and has long slender leaves. The bulbs grow in clusters. The bulbs may be red, brown, or gray. Shallots have a fine flavor that is stronger than that of onions but not as sharp. For this reason, they are often used in flavoring cooked foods. Nearly all of the commercial crop grows in Louisiana.

Scientific Classification. The shallot belongs to the lily family, *Liliaceae*. It is classified as genus *Allium*, species *A. ascalonicum*. ARTHUR JOHN PRATT

SHALMANESER III. See ASSYRIA (History).

SHAMAN, *SHAH mun*, is a medicine man or priest among certain peoples. The term came from a Mongolian word, but peoples in many parts of the world have shamans who supposedly cast out evil spirits or bring good. They may use dances, feasts, and chants. Shamans may be found among the Eskimos, Maoris, Mongolians, Polynesians, and others. American Indians had similar beliefs (see INDIAN, AMERICAN [Shamans]).

SHAMROCK is the national flower of Ireland (Eire). According to legend, St. Patrick planted it in Ireland because its three small leaves represented the Holy Trinity. All loyal sons of Eire still wear a shamrock in their lapels on St. Patrick's Day. The name *shamrock* is anglicized from *Seamrog*, which means trefoil (three-leaved). It is given to a number of plants, but a small clover is usually considered the true shamrock. Its leaves have a blue-green color. *Black medic*, *nonesuch*, *yellow trefoil*, and *hop clover* have been called shamrocks.

J. Horace McFarland

Shamrock

The shamrock appears with the thistle and the rose on the British coat of arms, because these are the national flowers of Ireland, Scotland, and England. Some authorities say the wood sorrel is the true shamrock. Its leaves are like those of the white clover. DONALD WYMAN

SHANG DYNASTY, *shahng*, was the earliest known Chinese *dynasty* (family of rulers). The dynasty governed from about 1500 B.C. to 1027 B.C. It was centered in what is now northern Honan province.

The Shang society, though based on agriculture, became famous for its fine carvings and bronze work. Most Shang relics found by scientists came from An-yang, the last Shang capital. An-yang had houses, palaces, temples, and elaborate tombs.

The people of the Shang period used bronze to make vessels, weapons, and chariot fixtures. They also carved marble and jade and wove silk. The Shang writing system had more than 3,000 symbols. This writing appears on pieces of bone called *oracle bones*. The people used oracle bones to ask the spirits of their ancestors about such future occurrences as crop raising, hunting trips, and wars.

The Shang society was headed by a priest-king and had two classes of people—commoners and nobles. The people worshiped their ancestors and had many gods. The two chief gods were what the people called a Ruler Above and a God of Earth. EUGENE BOARDMAN

See also CHINA (History [map]).

SHANGHAI, *SHANG hy* (pop. 10,820,000), China, ranks as the largest city in the world. It lies on the Whangpoo River. For location, see CHINA (political map). About 14 miles (23 kilometers) north of Shanghai, the Whangpoo and Yangtze rivers meet and empty into the East China Sea. Shanghai's location near these important waterways helps make it a leading Chinese port and industrial city.

Shanghai was a small trading town until the 1800's. In 1842, Great Britain forced China to open the city to foreign trade. Americans, Englishmen, Frenchmen, and other foreigners settled in Shanghai and gained great power in city affairs. They made the city one of the world's leading trading and banking centers. They built homes, churches, and tall office buildings, which gave much of Shanghai a Western appearance. The Chinese Communists took over Shanghai and the rest of China in 1949.

The City. Shanghai has three main parts. They are (1) the old foreign section in the north, (2) the original Chinese settlement in the south, and (3) suburban areas around these two sections. Shanghai's suburbs, unlike American suburbs, form part of the city.

The heart of Shanghai lies in the old foreign section, near the intersection of the Bund and Nanking Road. The Bund, a broad boulevard near the Whangpoo River, has skyscrapers built in the 1920's on one side and public gardens on the other side. Wharves and shipyards line the river beyond the gardens. Many department stores and restaurants lie along Nanking Road. An old British race track on the road has been made a sports stadium. Many skyscrapers in the foreign section now stand empty or serve as schools. Chinese families live in the residential areas where the foreigners used to live.

SHANGHAI

The original Chinese settlement, sometimes called the "Chinese City," lies south of the foreign section. It has residential and commercial buildings and narrow, twisting streets.

Since the mid-1900's, the Communist government has built 11 suburbs around old Shanghai. These suburbs include apartment buildings, factories, farms, schools, and shops.

Almost all the people of Shanghai are Chinese. Most of them work in factories and earn enough to be able to eat and dress well by Chinese standards. The city has many universities and research centers.

Economy. Shanghai lies in one of China's most important industrial areas. The city's factories make a wide variety of products. Iron mines west of the city help supply raw material for the manufacture of machinery and for shipbuilding. Textile mills make cloth from cotton grown in the nearby Yangtze Valley. Other products of Shanghai include cement, electrical equipment, and fertilizer. Farmers in the suburbs grow cereal grains, cotton, and vegetables.

Government. Shanghai lies in Kiangsu Province, but its government is independent of the provincial government. Since the mid-1960's, a committee that is controlled by the army has governed the city. Before that time, a committee of the Chinese Communist Party

Paolo Koch, Photo Researchers

Shanghai Skyscrapers that tower over the city's streets were built by foreigners in the 1920's. Foreign businessmen held power in the city for almost 100 years, until the 1940's.

Marc Riboud, Magnum

Shanghai, the World's Largest City, is a leading industrial center and port. Ships carry products made in the city's factories to the interior of China along the Yangtze River.

made government policies which local leaders carried out.

History. Shanghai developed as a small trading center during the Sung dynasty (960-1279). In 1842—at the end of the so-called "Opium War" between China and Great Britain—Britain forced China to open the town to foreign trade. Other nations soon gained trading rights, and Shanghai became a major trading center. British, French, Japanese, and U.S. citizens settled in Shanghai in special areas for foreigners called *concessions*. See CHINA (The "Unequal Treaties").

Foreigners and some Chinese businessmen set up banks and businesses in Shanghai. Many Chinese peasants moved to the city to find jobs. Most Chinese workers lived in slums in the old part of the city.

During the early 1900's, merchants, students, and workers protested against foreign influence. Some of them founded China's Communist Party in Shanghai in 1921. In 1927, the Chinese Nationalists killed many Communists and drove others from the city.

The Japanese captured Shanghai in 1937. They occupied the city until World War II ended in 1945. Great Britain and the United States gave up their concessions in Shanghai during the war, and France gave up its concession in 1946.

The Communists conquered China in 1949. They enlarged Shanghai and developed heavy industries. In 1966, Communist Party Chairman Mao Tse-tung called for a "cultural revolution" to rid the party of his enemies. As part of this revolution, *Red Guards* (student supporters of Mao) drove the Shanghai government from power. The city soon came under control of a committee directed by the army. RICHARD H. SOLOMON

SHANNON, MONICA (? -), an American author, received the Newbery medal in 1935 for *Dobry*, the story of a Bulgarian boy who longed to be an artist. Miss Shannon was born in Belleville, Ont., Canada, but grew up on a California ranch. She made friends with Bulgarian immigrants who worked on the ranch, and stories she heard from them became the basis for her book *Dobry*. She also wrote *California Fairy Tales* (1926) and *Goose-Grass Rhymes* (1930). She was a librarian in the Los Angeles Public Library from 1916 to 1925. EVELYN RAY SICKELS

SHANNON, RIVER, is the main waterway of Ireland and the longest river in the British Isles. The Shannon rises in Cavan County in upper Leinster and flows 250 miles (402 kilometers) southwest to the Atlantic Ocean. The river flows through many beautiful *loughs* (lakes). The river's mouth is 50 miles (80 kilometers) long. Limerick is the chief city on the river. An electric power project on the river was completed in 1929.

SHANTEY, or SHANTY. See CHANTEY.

SHANTUNG, *shan TUNG*, is a heavy grade of *pongee* (wild silk) woven in China. Shantung made of cotton, rayon, or cotton and silk mixtures imitates the silk shantung fabric. Rough-spun yarns of these fibers give the same effect as wild silk. Shantung has a plain weave, and is used in making curtains, sportswear, pajamas, robes, and women's summer suits. KENNETH R. FOX

SHAPE stands for Supreme Headquarters Allied Powers Europe. See NORTH ATLANTIC TREATY ORGANIZATION.

SHAPIRO, KARL JAY (1913-), is an American poet. In *Person, Place and Thing* (1942), he defends the blessings of individuality (*person*) against conformity; the searching examination of society (*place*) in contrast to uncritical allegiance; and the richness of the created *thing* as opposed to destruction.

Shapiro won the 1945 Pulitzer prize for poetry with *V-Letter and Other Poems*. His essays often express rebellion against rules for making or judging art. *The Bourgeois Poet* (1964) denounces the style of life and poetry, including his own, that lies within the safety of middle-class attitudes and formal verse.

Shapiro was born in Baltimore. He has taught in several colleges and he has edited two literary magazines, *Poetry* from 1950 to 1956 and *The Prairie Schooner* from 1956 to 1963. His *Selected Poems* was published in 1968 and his first novel, *Edsel*, in 1971. MONA VAN DUYN

SHAPLEY, *SHAP lee*, **HARLOW** (1885-1972), an American astronomer, studied clusters of stars called *globular clusters*. These clusters lie far out at the edge of the Milky Way, the galaxy to which our solar system belongs. Shapley concluded from his studies that the diameter of the Milky Way is about 100,000 light-years and that the center of the galaxy lies near the constellation Sagittarius.

Shapley served as astronomer at the Mount Wilson (Calif.) Observatory from 1914 to 1921. He was professor of astronomy at Harvard University and director of the Harvard Observatory from 1921 to 1952. He worked to organize science on an international, as well as national, scale. He was born in Nashville, Mo., and studied at the University of Missouri. HELEN WRIGHT

SHARAKU TOSHUSAI, the most individual Japanese print artist of the late 1700's, was also a dancer employed by one of the great feudal families. These two sides of his career belonged to separate worlds. One was the conservative, formal, and severely disciplined society of the aristocrats; the other, the pleasure-seeking world of city merchants and workers.

The details of Sharaku's life are not known. To make the break so successfully he must have been unusually bored and reckless. His prints, by their brilliant impudence, suggest a strange, harsh personality. All his dated works fall within one year, 1794. His best-known actor portraits are drawn almost like caricatures in awkward, forceful poses. ALEXANDER C. SOPER

See also JAPANESE PRINT (picture: Portraits of Actors).

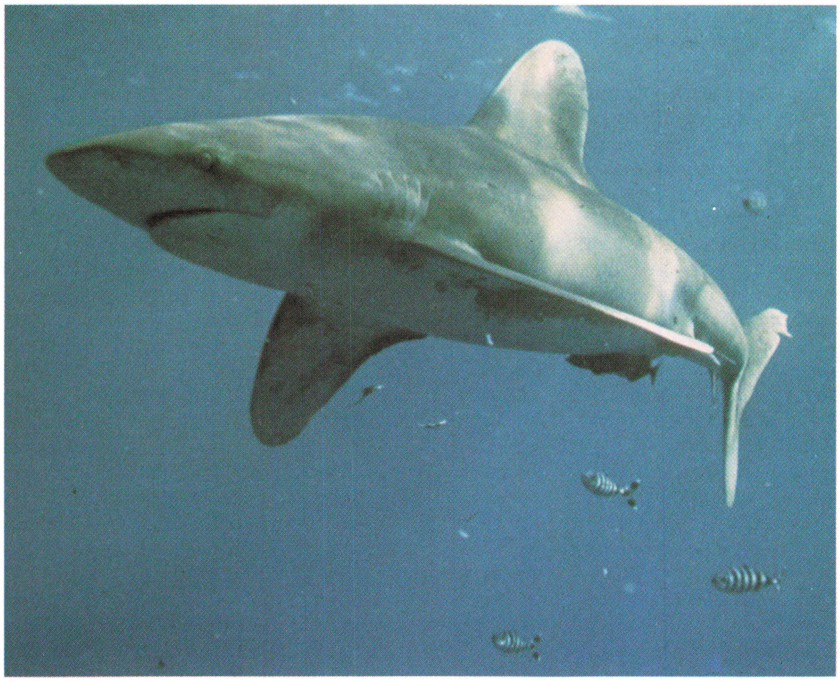
SHARE. See STOCK, CAPITAL.

SHARECROPPER is a farmer who grows crops on another person's land. He usually shares the crops equally with the owner. The sharecropper usually supplies all the labor. The landowner supplies the land, a house and garden, farming equipment, and machinery or work animals. He may also supply fertilizer, insecticides, and cash or credit for family living.

Sharecropping was once widespread in the southern United States, mainly on cotton and tobacco farms. It has nearly disappeared in recent years. MARSHALL HARRIS

See also AGRICULTURE (The United States).

SHARIA, *shah REE uh*, is the sacred law of Islam. The word *sharia* means *the road to the watering place*, or *the clear path to be followed*. The Sharia is made up of all Allah's commandments relating to man's activities. It prescribes regulations for worship and ritual, and for political and legal activities. ALI HASSAN ABDEL-KADER



The Shark has a graceful, torpedolike body. The fish's streamlined shape enables it to move swiftly through the water with little effort. The whitetip shark, *left*, one of the most common species of shark, is named for the white markings on the tips of its fins.

Peter Lake from Peter Schub

SHARK is a meat-eating fish and one of the most feared animals of the sea. Scientists classify about 250 species of fish as sharks. These fish live in oceans throughout the world, but they are most common in warm seas.

Sharks vary greatly in size and habits. Whale sharks, the largest kind of shark—and the largest of all fish—may grow 60 feet (18 meters) long. A whale shark weighs up to 15 short tons (14 metric tons), more than twice as much as an African elephant. The smallest sharks may measure only 4 inches (10 centimeters) long and weigh less than 1 ounce (28 grams). Some kinds of sharks live in the depths of the ocean, but others are found near the surface. Some species live in coastal waters, but others dwell far out at sea. A few species can even live in fresh water.

All sharks are *carnivores* (meat-eaters). Most of them eat live fish, including other sharks. A shark's only natural enemy is a larger shark. Sharks eat their prey whole, or they tear off large chunks of flesh. They also feed on dead or dying animals.

Sharks have the reputation of being man-eaters, but fewer than 100 shark attacks a year are reported throughout the world. About 25 species of sharks have been known to attack human beings.

The Body of a Shark

Sharks differ from most other kinds of fish in a number of ways. For example, sharks have no bones. Their skeleton is made of a tough, elastic substance called *cartilage*. Most species of sharks have a rounded body, shaped somewhat like a torpedo. This streamlined shape aids in swimming. Angel sharks and a few other species that live near the ocean bottom have a flat body similar to that of skates and rays.

The body of a newborn shark resembles that of an adult in almost every way except size. Sharks have fewer young at a time than most fish do. Some species give birth to 60 or more *pups* in a litter, but most have far fewer. The parents do not take care of the young—and may even eat them.

Shark eggs, unlike those of most fish, are fertilized inside the female's body. The male shark has two organs called *claspers*, which release sperm into the female, where it fertilizes the eggs. Among most species of sharks, the eggs hatch inside the female, and the pups are born alive. A few species lay their eggs.

Tail and Fins. Sharks can travel with great bursts of speed when excited. Scientists recorded a blue shark traveling at bursts of 43 miles (69 kilometers) per hour. Most sharks have a crescent-shaped tail that provides power for swimming. The upper part of the tail is longer than the lower part. Stiff *pectoral* (side) fins help lift and balance the front of the body.

Most fish have a *swim bladder*, a gas-filled organ that helps them remain at a certain depth without sinking. Sharks lack this organ. Instead, they have a large liver filled with oil. This oil is lighter than water, and it helps the shark keep from sinking. Even so, most kinds of sharks must swim constantly—from the moment they are born—or they will sink.

Teeth and Scales. A shark's mouth is on the underside of the head among all species except whale sharks. The mouth of a whale shark is at the front of the head. A shark has several rows of teeth. When an old tooth wears out or is lost, a new one grows in and replaces it. Some sharks have molarlike grinding teeth. Others have razorlike cutting teeth, and still others have pointed teeth. Some persons believe that sharks must turn over on their back to bite, but this is not true.

Small, toothlike scales cover a shark's body. These *placoid* scales make the skin of a shark very rough. Sharkskin, called *shagreen*, was once used as sandpaper.

Gills. Sharks get oxygen from the water through gills, as do other fish. But sharks have no *gill cover*, a bony plate that shields the gills of most fish. Instead, sharks have from five to seven slits in the skin on each side of the head. Water passes out of these slits after the shark's gills remove the oxygen. Most sharks cannot pump water over their gills, as do the majority of fish. Sharks rely on their constant swimming to force water through their mouth and over their gills.

Senses. Sharks have keen senses, which they use in hunting. Their sense of smell is particularly well developed. As much as two-thirds of a shark's brain may be used in connection with smelling. Sharks can sense some odors, such as that of blood, $\frac{1}{4}$ mile (0.4 kilometer) away. Sharks also have excellent hearing. They can hear a struggling fish or a human swimmer at a considerable distance, perhaps as far as 1,000 yards (910 meters).

Sharks were once thought to have poor vision. They cannot see sharp details, but they use their eyes in attacking prey. In clear water, a shark can easily pick out a moving object from its background as far as 50 feet (15 meters) away.

Like other fish, sharks have a sensitive organ called a *lateral line system* that serves to detect vibrations in the water. This system of fluid-filled canals runs down both sides of the body. It enables sharks to feel vibrations from about 100 feet (30 meters) away.

Kinds of Sharks

Scientists do not know exactly how many kinds of sharks there are. They frequently identify new species. But sometimes they find that two sharks that had been considered different species are actually the same. This section describes some of the best-known sharks.

Basking Sharks measure up to 40 feet (12 meters) long and live in cool temperate waters. They eat only small animal and plant life called *plankton*. These sharks have the habit of floating on the surface and *basking* (warming themselves) in the sun.

Bull Sharks can live in fresh water. They often enter rivers that empty into the sea, and they have attacked swimmers. The bull sharks in Lake Nicaragua, in Nicaragua, may have become completely adapted to living in fresh water.

Hammerhead Sharks, which include a number of similar species, rank among the strangest-looking sharks. They have a flattened head, which in most of the species resembles the head of a hammer. Their eyes and nostrils are at the ends of the "hammer." The largest hammerhead, the *great hammerhead*, is about 15 feet (4.6 meters) long. Hammerheads live in shallow tropical and warm temperate waters and have attacked people.

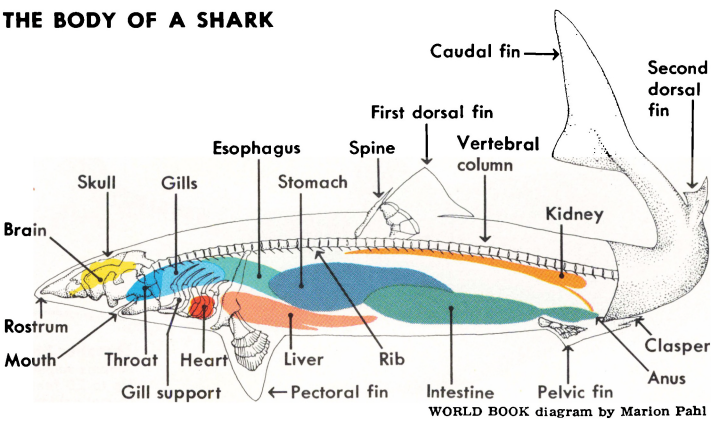
Mako Sharks are swift, powerful creatures. They are considered one of the best species of game fish among all the sharks. When hooked, a mako fights the fisherman by leaping high into the air. Most makos live in tropical and warm temperate waters. They may reach a length of 12 feet (3.7 meters). Makos feed on other fish, including herring, mackerel, and swordfish. These sharks have attacked small fishing boats and may have attacked swimmers as well.

Nurse Sharks are slow-moving fish that may grow up to 14 feet (4 meters) long. They live among reefs in shallow tropical and subtropical waters. Unlike most species of sharks, the nurse shark can pump water over its gills. Therefore, it does not have to swim constantly and often lies motionless on the sea bottom. Nurse sharks eat bottom-dwelling fish as well as crabs, lobsters, sea urchins, and shrimp. They have attacked people. But most of these attacks were caused by the victim, who foolishly grabbed a motionless nurse shark by the tail.

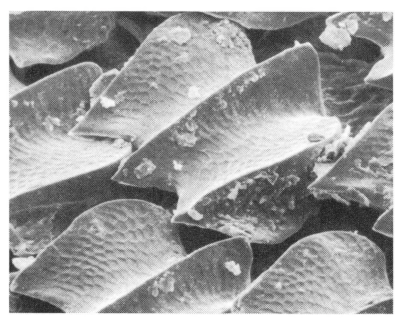
Jerry Greenberg

The Mouth of a Bull Shark has two rows of razor-sharp teeth. Whenever a tooth is lost, a new one takes its place. The replacement teeth lie out of sight along the inside of the jaws.

THE BODY OF A SHARK



WORLD BOOK diagram by Marion Pahl



Kent Cambridge Scientific, Inc.

A Shark's Skin is covered with tiny toothlike scales. The scales pictured above were photographed with an electron microscope.

Thresher Sharks are long-tailed subtropical fish that swim along the surface. They grow to a length of about 20 feet (6 meters), of which half is the tail. Biologists believe the thresher uses its long tail to gather into "herds" the fish it feeds on and to stun fish before eating them. No thresher shark has been known to attack a human being.

Whale Sharks, in spite of their enormous size, eat only plankton and small fish. Therefore, they are harmless to man. Whale sharks live in tropical waters.

White Sharks, also known as *man-eaters*, rank as the most dangerous sharks. Most measure about 20 feet (6 meters) long, and live in tropical and warm waters. They swim powerfully and prey on such large animals as sea lions, tuna, and other sharks. They have attacked human beings and even small fishing boats.

Sharks and Man

Shark Attacks. Only about a tenth of the approximately 250 species of sharks are considered dangerous to human beings. But most of the shark attacks that do occur result in death or serious injury. Swimmers should take special care in areas known to have sharks.

People once thought that sharks ate constantly and would therefore attack any human being immediately. But scientists have learned that these fish can go for weeks or even months without feeding. During this time, the oil stored in their liver nourishes them.

Scientists do not know why sharks sometimes attack people and at other times leave them alone. The American Institute of Biological Sciences sponsors a Shark Research Panel that studies shark attacks throughout the world. The panel has listed safety rules for people who swim in water where sharks may be nearby. These rules include the following:

(1) Never swim or dive alone.

(2) Never swim or dive with an open wound. Blood attracts sharks.

(3) Never swim or dive at night or in dirty water, where there is less chance of spotting a shark.

(4) Leave the water immediately if a shark is sighted. Swim as smoothly as possible because thrashing movements might attract the shark.

(5) Never grab or injure any shark, even a small and apparently harmless one.

How Man Uses Sharks. Commercial fishermen catch sharks mainly for their hides and flesh. Shark hide makes an especially long-wearing leather after the scales have been removed. People in various parts of the world eat the flesh of many species of sharks. In Great Britain, for example, sharks are often used in preparing *fish and chips*, which consists of fried fish and French fried potatoes. Orientals use dried shark fins in making a popular soup. People in parts of Africa and Latin America also eat shark. Most North Americans do not eat the fish.

The liver oil of certain species of sharks contains large amounts of vitamin A. Until the late 1940's, when scientists discovered an inexpensive way to manufacture vitamin A, shark liver oil ranked as a main source of this vitamin. Commercial shark fisheries once thrived in North American waters, but they depended mainly on the demand for shark liver oil. Today, few North American fishermen engage in commercial shark fishing.

Since the late 1950's, sharks have been used increasingly in scientific research. Scientists study the bodies and organs of sharks in order to better understand the human body. They also study how sharks react to such diseases as cancer and influenza.

Scientific Classification. Sharks make up the order *Squaliformes*, which is divided into about 19 families. Mako sharks, porbeagles, and white sharks make up the family *Isuridae;* hammerhead sharks, the family *Sphyrnidae;* thresher sharks, the family *Alopiidae;* whale sharks, the family *Rhincodontidae;* and basking sharks, the family *Cetorhinidae*. Bull, lemon, and tiger sharks are in the family *Carcharhinidae*. Nurse sharks are in the family *Orectolobidae*.

WARREN J. WISBY

See also ANIMAL (picture: Animals of the Oceans); DOGFISH; FISH, with pictures; OCEAN (picture: Life in the Ocean); REMORA.

SHARK SUCKER. See REMORA; SYMBIOSIS.

SHARON, *SHAIR un,* **PLAIN OF,** is part of the coastal plain of Israel. Averaging about 10 miles (16 kilometers) in width, it stretches 50 miles (80 kilometers) between Mount Carmel and Tel Aviv-Yafo (Jaffa). The Plain of Sharon contains rich farming land. This region is the most densely populated area in Israel.

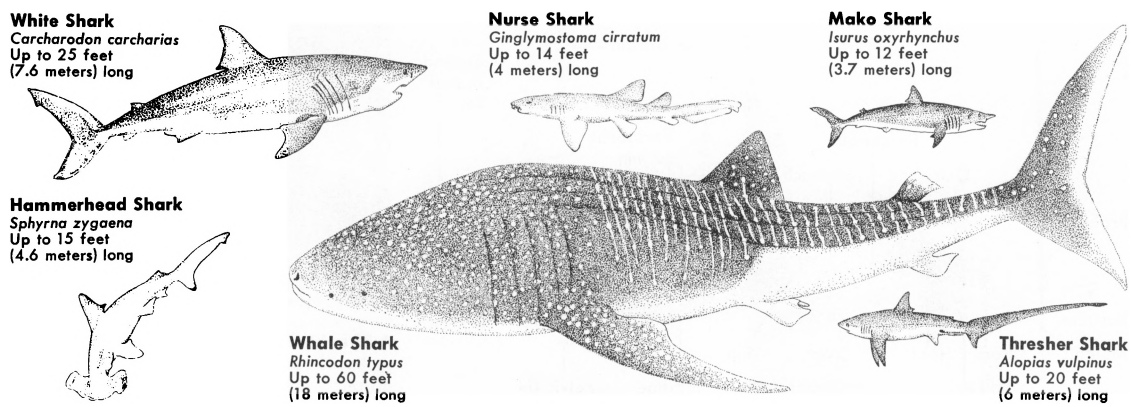
SHARON, ROSE OF. See ROSE OF SHARON.

SHARPS AND FLATS. See MUSIC (Sound in Music).

SHASTA, MOUNT. See MOUNT SHASTA.

SOME KINDS OF SHARKS

WORLD BOOK illustration by Marion Pahl



SHASTA DAISY. See BURBANK, LUTHER (His Achievements); DAISY (picture).

SHASTA DAM, located on the Sacramento River about 12 miles (19 kilometers) north of Redding, Calif., is the second highest concrete dam in the United States. It is a feature of the Central Valley Project in California (see CENTRAL VALLEY PROJECT). Its spillway drops 480 feet (146 meters), making it the highest overflow dam in the world. The reservoir created by Shasta Dam provides irrigation water and electric power. The dam is 602 feet (183 meters) high, 3,460 feet (1,055 meters) long, and contains 8,711,000 cubic yards (6,660,000 cubic meters) of concrete. The reservoir extends 35 miles (56 kilometers) from the dam up the Sacramento, Pit, and McCloud rivers. It has a capacity of $4\frac{1}{2}$ million acre-feet (5.6 billion cubic meters). The United States Bureau of Reclamation built the dam in 1945. See also LAKE (picture).

T. W. MERMEL

SHASTINA. See MOUNT SHASTA.

SHASTRI, LAL BAHADUR (1904-1966), became prime minister of India in June, 1964, after the death of Jawaharlal Nehru. Shastri won a reputation as a mild-mannered, efficient, political moderate, and as a man skilled at compromise.

Shastri was born in the Banaras district of eastern India. He graduated from Kashi Vidyapith, which is a Hindu nationalist university. He entered politics and joined the Indian National Congress in the 1920's. Shastri took an active part in Mahatma Gandhi's movement for Indian independence and was arrested several times in the 1930's and 1940's.

After India gained independence in 1947, Shastri became minister for police and transport of the state of Uttar Pradesh. In 1951, he became general secretary of the Indian National Congress. He directed the national ministries of transport and railways, communication, commerce and industry, and home affairs before becoming prime minister of India. Shastri died in Tashkent, Russia, in January, 1966, just a few hours after signing a nonaggression pact with Pakistan (see INDIA [Recent Developments]).

RICHARD L. PARK

SHATT AL ARAB is a river in Iraq and Iran. It is formed by the meeting of the Tigris and Euphrates rivers at Al Qurnah, Iraq, and flows 120 miles (193 kilometers) to the Persian Gulf. The Karun River of Iran also joins the Shatt al Arab. The oil port of Abadan, Iran, and the city of Basra, Iraq, are on the river.

SHAW, ANNA HOWARD (1847-1919), was an American preacher, physician, and woman's rights advocate. She was ordained a Methodist minister in 1880, and received her medical degree from Boston University in 1886. She began to work closely in 1888 with Susan B. Anthony in the National Woman Suffrage Association, and became its president in 1904. By 1915, when she became honorary president, she had raised the membership from 17,000 to 200,000. During World War I, she served as chairman of the Women's Division of the Council of National Defense. She was born in Newcastle upon Tyne, England.

LOUIS FILLER

SHAW, GEORGE BERNARD (1856-1950), an Irish-born dramatist, critic, and essayist, ranks as one of the most important literary figures of the 1900's. He won the Nobel prize for literature in 1925.

Shaw disliked the romantic and sentimental Victorian theater of the late 1800's. Influenced by the revolutionary social dramas of the Norwegian playwright Henrik Ibsen, he viewed the theater as a platform for supporting social reform. In a remarkable career that covered nearly 60 years, he wrote over 50 plays. Most of them are comedies in which a debate on ethics is as important as traditional dramatic values such as character and appeals to the emotions of an audience.

Shaw was a mischievous and original thinker. He defended women's rights, became a vegetarian, and promoted a simplified alphabet. He defended his opinions in a series of essays, many published as prefaces to his plays. Like the plays, the essays are charming for their brilliance and wit, even when the causes they argue no longer seem daring or unconventional.

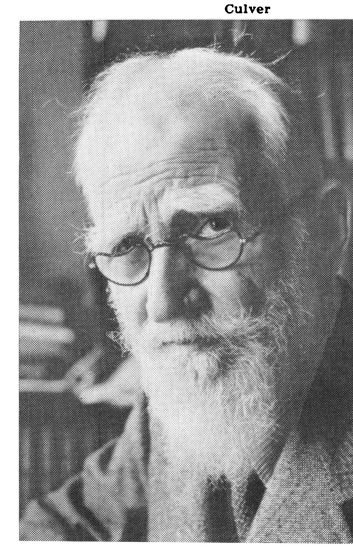
Early Life. Shaw was born in Dublin on July 26, 1856. He moved to London in 1876, and became a successful music critic. In 1884, he helped found the Fabian Society, an organization of socialists who believed that political and economic change could be gained through reform. It was for the Fabian Society that Shaw prepared a famous lecture on Ibsen, later published as *The Quintessence of Ibsenism* (1891).

Because of their radical subject matter, Shaw's early plays did not become popular immediately in London. His first play, *Widower's Houses* (1892), attacked slum landlords. *Mrs. Warren's Profession,* which deals with the causes of prostitution, was written in 1893. But it was not produced until 1902, and then was immediately banned. *Arms and the Man* (1894), an entertaining antiwar comedy, was only mildly successful when it first opened.

Mature Period. Public hostility to Shaw began to disappear after 1904, when his friend Harley Granville-Barker produced 11 of his plays in less than three years at the Royal Court Theatre. These included *Candida* (1895), *The Devil's Disciple* (1897), *Caesar and Cleopatra* (1898), and *Man and Superman* (1903). This last play contains the celebrated scene "Don Juan in Hell," which is often performed as a separate work.

Man and Superman introduced Shaw's theory of what he called the "life force." To Shaw, the "life force" was the energy that dominates man biologically. However, when harnessed by man's will, the "life force" can lead to a higher, more creative existence. This concept is central to Shaw's most ambitious play, the five-part *Back to Methuselah* (1918-1920), a fable that traces the entire history of mankind. It foresees a curious future for the human race as a new, more intelligent species, but predictable and unexciting.

George Bernard Shaw
Culver



Saint Joan (1923), a drama about the individual in conflict with historical necessity, is widely regarded as Shaw's masterpiece. But some critics prefer *Pygmalion* (1912). This ironic Cinderella story describes how a professor of *phonetics* (speech sounds) demonstrates the absurdity of class distinctions by

changing an ignorant Cockney girl into a counterfeit aristocrat by changing her speech (see PYGMALION). The play was adapted into the musical *My Fair Lady* (1956). Shaw's other plays include *Major Barbara* (1905), *The Doctor's Dilemma* (1906), *Androcles and the Lion* (1913), and *Heartbreak House* (1919). RALPH G. ALLEN

SHAW, HENRY WHEELER. See BILLINGS, JOSH.

SHAW, IRWIN (1913-), an American dramatist, short-story writer, and novelist, pictured the threats to free men embodied in fascism and other restrictive forces. He showed his sympathy with common men in his first play, *Bury the Dead* (1936). His novel *The Young Lions* (1948) tells about the lives and development of three soldiers fighting in World War II. He also wrote *Voices of a Summer Day* (1965). Shaw was born in New York City. HARRY R. WARFEL

SHAW, ROBERT (1916-), is one of the outstanding choral conductors of his time. His choruses are known for their technical skill and the vitality of their singing. Shaw excels with highly dramatic works that require large choruses.

Shaw was born in Red Bluff, Calif. He achieved his first musical success with the Collegiate Chorale, which he organized in 1941. In 1948, he formed the Robert Shaw Chorale. Shaw is also a noted orchestra conductor. He conducted the San Diego Symphony Orchestra from 1953 to 1958. Shaw served as associate conductor of the Cleveland Symphony from 1956 to 1967, when he became musical director of the Atlanta Symphony. KEITH POLK

SHAW, WILBUR (1902-1954), was an American racing car driver. He won the annual Indianapolis 500-mile race three times and finished second three times, a record performance. He won in 1937, 1939, and 1940, and was second in 1933, 1935, and 1938. He retired from racing in 1941, and worked for a rubber company. He became president and general manager of the Indianapolis Speedway, site of the race, in 1946. Shaw was born in Shelbyville, Ind. He was killed in an airplane crash at Decatur, Ind., in 1954. PAT HARMON

SHAWINIGAN, *shuh WIN ih gun*, Quebec (pop. 27,792), is an important industrial center on the St. Maurice River. It lies about 20 miles (32 kilometers) north of Trois-Rivières (see QUEBEC [political map]).

A waterfall north of Shawinigan provides electric power for the city's industries. The Shawinigan Water and Power Company, formed in 1898, is one of the world's largest privately owned electric-power companies. Products of Shawinigan include abrasive materials, aluminum, carbide, chemicals, lumber, paper, pulp, resins, and stainless steel products. Shawinigan was founded in 1901. MURRAY G. BALLANTYNE

SHAWN, TED (1891-1972), was a pioneer in establishing the role of the male dancer in America. Shawn developed his own method for training male dancers. He also created dances for men based on American Indian and Western folklore and on modern themes.

Edwin M. Shawn was born in Kansas City, Mo. In 1915, he and his wife, Ruth St. Denis, formed the Denishawn dance company. He trained dancers and toured with his wife and the company until 1931 (see SAINT DENIS, RUTH). From 1933 until 1940, Shawn headed his own performing group of male dancers. He created and starred in several ballets, including *Invocation to the Thunderbird*, *Gnossienne*, and *St. Francis*. In 1941, Shawn established a summer dance school and festival at Jacob's Pillow, in Lee, Mass. The festival has provided a showcase for both established and young dancers, and for notable foreign companies. SELMA JEANNE COHEN

See also UNITED STATES (The Arts in the United States [picture: The Dance]).

SHAWNEE INDIANS lived in the eastern forests of North America. They spoke an Algonkian language, and were closely related to the Sauk and Fox Indians. We know little about their way of life, because they split into many wandering groups and lived away from well-traveled routes. The Shawnee built wigwam villages along riverbanks in such states as Ohio, West Virginia, Pennsylvania, and Tennessee.

In the middle 1700's, many groups of Shawnee settled together on the banks of the Ohio River in Pennsylvania, Ohio, Virginia, and West Virginia. For 40 years they fought against settlers in these regions, and became known as the most hostile tribe in the area. In 1774, under the leadership of their chief, Cornstalk, the Shawnee met defeat at the Battle of Point Pleasant, which ended Lord Dunmore's War.

After their defeat, many of the Shawnee moved across the Mississippi River. Those who remained behind included Chief Tecumseh and his brother Tenskwatawa, known as the Shawnee Prophet. They tried to unite all the Indians of the Mississippi Valley against the whites, but were defeated by William Henry Harrison at the Battle of Tippecanoe in 1811. Most Shawnee now live on reservations in Oklahoma. WAYNE C. TEMPLE

See also INDIAN WARS (Along the Frontier); SHAWNEE PROPHET; TECUMSEH; CORNSTALK; KANSAS (Communication).

SHAWNEE PROPHET (1775?-1837?) was the brother of the great Shawnee Indian chief, Tecumseh. He was known by the Indian name of TENSKWATAWA. He once fell as though dead. Just as his friends were ready to bury him, he came back to life. He claimed he had been lifted to heaven and shown all about the past and future. In 1806, he predicted an eclipse of the sun. After that, Indians believed what he said. He said Indians should give up everything that came from the white man. He gave hope to the eastern tribes, who were trying to keep the whites out of their territory. He lost the Battle of Tippecanoe, however, and his tribe was disbanded. The Shawnee Prophet's place of birth is not known. E. ADAMSON HOEBEL

See also TECUMSEH.

SHAWNEE TRAIL. See COWBOY (Beginnings).

SHAYS' REBELLION was a revolt by debtor farmers against their creditors and against the high taxes collected in Massachusetts during the 1780's. The rebellion was part of widespread discontent among small property owners and farmers in the United States after the Revolutionary War. Many of these persons faced imprisonment because they could not pay their debts.

Daniel Shays was one of several men who became leaders of the rebellion. Shays had served in the Revolutionary War, and after 1780 he held political offices at Pelham, Mass. His sympathy for the farmers led him to take an active part in their protests, and the movement was named for him. In 1786, unrest among farmers and debtors grew into revolt. Shays led a mob of about 600

persons that gathered in front of the courthouse at Springfield, Mass. The mob threatened the supreme court, and hoped to prevent the court from allowing the foreclosure of farms and imprisonment of debtors.

Skirmishes took place between the rebels and the state militia. Major General Benjamin Lincoln finally subdued the rebels on Feb. 2, 1787. Shays escaped to Vermont with a death penalty on his head. He was later pardoned.

The fears that were aroused by the rebellion helped to produce a stronger central government in the United States. As a result of the rebellion, the Annapolis Convention's call for a revision of the Articles of Confederation gained strength throughout the nation (see ANNAPOLIS CONVENTION). This eventually led to the adoption of the United States Constitution. MERRILL JENSEN

SHAZAR, SCHNEOR ZALMAN, *shah ZAHR* (1889-1974), served as president of Israel from 1963 to 1973. He devoted much of his life to the cause of *Zionism* (formation of a Jewish state).

Shazar was born Schneor Zalman Rubashov in Minsk, Russia. He formed *Shazar* from letters in his name. He became a Zionist in 1905, and started a German Zionist movement in 1916, while studying in Germany. Shazar settled in Palestine in 1924. As cofounder and editor of *Davar*, a Labor Zionist daily newspaper, he helped build the power of the Israeli labor movement. Israel became a state in 1948. Shazar held several government posts and helped shape Israel into a modern nation. He wrote on history, literature, politics, religion, and other subjects. ELLIS RIVKIN

SHEARER, THOMAS. See FURNITURE (Thomas Shearer).

SHEARING STRESS. See STRENGTH OF MATERIALS.

SHEARS. See SCISSORS.

SHEARWATER is the name of a group of sea birds that live in the oceans. They vary in length from 12 to 20 inches (30 to 51 centimeters). Shearwaters have long slender wings and soar over the waves, flapping their wings only occasionally. Some fly alone, others gather in flocks that may include thousands. They eat fish, squids, and small crustaceans. Some shearwaters are grayish-black above and white underneath.

The shearwater comes to shore only to reproduce, usually on an island. Here it lays one large white or yellowish-white egg in a hole dug in the ground, or concealed under rocks. There are many species of shearwater. One of the best known is the *greater shearwater*, which lives in the Atlantic Ocean from near the Arctic Circle to southern South America and South Africa. Fishermen in the north call it hag or hagdon. Other species that live in North American waters are the *black-vented shearwater*, the *pink-footed shearwater*, the *New Zealand shearwater*, and the *sooty shearwater*.

Scientific Classification. Shearwaters belong to the order *Procellariiformes* and the shearwater family, *Procellariidae*. The greater shearwater is genus *Puffinus*, species *P. gravis;* the black-vented is *P. opisthomelas;* the pink-footed is *P. creatopus;* the New Zealand is *P. bulleri;* and the sooty shearwater is *P. griseus.* ALEXANDER WETMORE

SHEATHING. See HOUSE (Terms; The Frame).

SHEBA, QUEEN OF. See SOLOMON (His Wisdom).

SHEBOYGAN, Wis. (pop. 48,484), is a Lake Michigan port at the mouth of the Sheboygan River. It has been called *the City of Cheese, Chairs, Children, and Churches.* Sheboygan lies in the heart of a rich dairy-farming region. For location, see WISCONSIN (political map). Sheboygan has furniture factories, plastics firms, and woodworking plants. The city is the home of Lakeland College. Sheboygan's first settlement was established in 1834. The city was chartered in 1853. It has a mayor-council government. JAMES I. CLARK

SHECHEM. See CITIES OF REFUGE.

SHEE. See FAIRY (Leprechauns).

SHEELER, CHARLES (1883-1965), was an American painter and photographer. He was among the first American artists whose work shows the influence of cubism. Sheeler is best known for paintings that blend realism with the geometric forms associated with cubism. This style can best be seen in Sheeler's paintings of architectural forms, both interior and exterior.

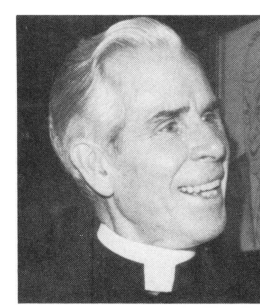
Sheeler was born in Philadelphia. The style of his early paintings shows the influence of his art teacher, William Merritt Chase. Sheeler's paintings took on cubistic characteristics, especially after he exhibited in the Armory Show of 1913. In the late 1920's, Sheeler's work in industrial and architectural photography influenced his art. His paintings became precise and realistic while retaining the influence of cubism. GEORGE EHRLICH

SHEEN, FULTON JOHN (1895-), is one of the best-known spokesmen for the teachings of the Roman Catholic Church in the world. His more than 50 books, along with his articles, have brought Catholic doctrine to millions of people around the world.

In 1950, he resigned as professor at the Catholic University of America to direct the Society for the Propagation of the Faith in the United States. This is an international mission aid society which raises and distributes money for the support of Roman Catholic missionaries throughout the world. The year after his appointment to that post, he was named titular bishop of Cesariana. In 1966, he was named the bishop of the diocese of Rochester, N.Y., by Pope Paul VI. Bishop Sheen resigned from that position in 1969 and was named titular archbishop of Newport, Wales.

As early as the 1920's, he was a vigorous opponent of Communism in his writings and radio talks on "The Catholic Hour," a national program. During the 1950's, he became widely known as a television personality for his "Life Is Worth Living" series.

Bishop Sheen was born in El Paso, Ill., and attended St. Paul Seminary. After his ordination in 1919, he studied philosophy at universities in the United States and Europe. In 1926, he began teaching at the Catholic University of America, and published his first book, *God and Intelligence in Modern Philosophy.* Bishop Sheen also wrote *Communism and the Conscience of the West* (1948), *Peace of Soul* (1949), *Life Is Worth Living* (1953), and *The Priest Is Not His Own* (1963). JOHN TRACY ELLIS



Wide World

Fulton J. Sheen

John Moss, Colorific

Cheviot and Leicester Crossbreed

Sheep provide clothing and food for man. The warm, fleecy hair that covers the bodies of domestic sheep is made into comfortable wool cloth. Many people enjoy the strong taste of mutton or the milder taste of tender lamb. People in nearly every part of the world raise sheep.

SHEEP are among the most important animals that man has tamed because they provide both food and clothing. Long before man began to write history, shepherds watched the flocks in the fields to guard them against wild animals. Today sheep are raised in all parts of the world. Australia is the world's leading sheep-producing country, raising about one-sixth of the world's sheep. In Australia, there are about 15 sheep for every person. In New Zealand, there are about 20 sheep for every person. Some states in the western United States also have more sheep than people. Sheep yield wool, meat, and leather. They also furnish the raw materials for many byproducts, such as glue, tallow, suet, soap, fertilizer, cosmetics, and the catgut used in stringing tennis rackets.

The Body of the Sheep

Domestic sheep vary greatly in size. The *ewes* (females) of some breeds may weigh as little as 100 pounds (45 kilograms). Other ewes may weigh more than 225 pounds (102 kilograms). The *rams* (males) are larger. Their weight, including a heavy coat of wool, ranges from 150 to 350 pounds (68 to 159 kilograms).

Sheep are different from goats in many ways. They do not have the familiar beard of the billy goat, nor the well-known "goaty" odor. Sheep have a gland between their toes which is not found among the goats. The horns of a ram usually curve outward. In some breeds, both rams and ewes have horns. In other kinds, only the rams have horns, or the breed is hornless.

Sheep walk upon hoofs that are divided into two toes. Their ankles are slim. The upper part of their legs is muscular, helping them to move quickly and easily.

Sheep have no incisor, or cutting, teeth on their upper jaws, though they have eight on their lower jaws. They have six grinding teeth on the back part of each jaw. Sheep can bite off grass much closer to the ground than cattle can. In fact, where sheep have eaten their fill, there is little plant life left. Most sheep have tails, but these are cut off for reasons of cleanliness.

Sheep live for about 13 years. They begin breeding at the age of about two years, and have young every year after that. The mother carries the young sheep inside her body about five months before it is born.

Wild Sheep

Sheep are supposed to have come originally from the lofty plateaus and mountains of Central Asia. The largest wild sheep, the *argali*, lives in the Altai Mountains of Siberia and Mongolia. The male argali stands 4 feet (1.2 meters) high at the shoulders. His spiral horns are 20 inches (51 centimeters) around.

The great Marco Polo sheep of Asia live on the plateaus of Pamir, the "roof of the world," 3 miles (5 kilometers) above sea level. This sheep was first described by Marco Polo. The Marco Polo sheep is a little smaller than the argali, but it is remarkable for the wide spread of its horns. The *blue sheep*, or *bharal*, which is closely related to the goat, lives in Tibet. About half a dozen other kinds of wild sheep live in Asia.

Wild sheep look much like wild goats. Some kinds of wild sheep are thought to be halfway between sheep and goats. Wild sheep are high-spirited, daring, and self-reliant. They brave the fiercest storms of winter and climb higher than any other animals but mountain goats. Wild sheep live in bands among the mountains and plateaus of the Northern Hemisphere.

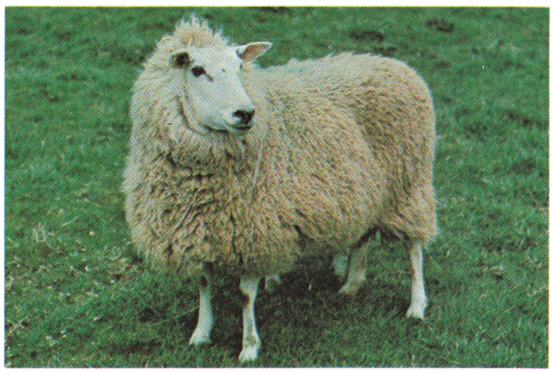
All the domestic breeds of sheep are descended from two different kinds of wild sheep. These are the *urial* that lives in Southern Asia, and the *mouflon*, which is the only kind of wild sheep still living in Southern Europe. Both of these sheep probably resemble their original

E. S. Ross

Karakul

Lia Munson

Suffolk and Corriedale Crossbreed



Tony Carr, Colorific

Colbred

G. R. Roberts

Romney

ancestors. Many kinds of bighorn sheep live in North America.

Breeds of Domestic Sheep

Domestic sheep have been slowly and carefully changed from their wild ancestors. Originally, the wild sheep were tamed for the sake of their hides and milk. They were also used to carry burdens. Very early they became important for their fleece. The coarse hair that covered the wild sheep was replaced by a soft coat of wool through breeding. Only in the last 200 years have breeders developed sheep primarily for their meat.

Sheep are classified into five groups, depending upon their fleece. These are *fine wool*, *long wool*, *crossbred wool*, *medium wool*, and *coarse wool*. The coarse wool group is of little importance.

Fine-Wooled Sheep. Most of our fine-wooled sheep originated from the Spanish Merino. These sheep were raised in Spain as far back as history has been written. Spanish Merino sheep were greatly prized. The Spanish government forbade taking them out of the country but many were smuggled into Germany, France, and England. It was in these other countries that the Merino was developed into the modern type of sheep.

There are more sheep with Merino blood than any other breed. American Merino sheep have white faces and legs, and are thickly covered with fine wool down to their toes and noses. Rams usually have horns.

Adam Woolfitt, Woodfin Camp, Inc.

Cheviot

The *Rambouillet* is another important breed which is descended from the Spanish Merino. It is named after a town in France, but it was largely developed in Germany, and, later, in the United States. The breed began more than 150 years ago. This breed is very hardy. The *Debouillet* breed was developed in New Mexico about 1920. This breed was developed to produce wool and mutton under difficult range conditions.

Long-Wooled Sheep. Four of the most important long-wooled breeds come from England. They are the *Lincoln*, *Leicester*, *Cotswold*, and *Romney*. Lincoln sheep are among the largest of domestic sheep, and produce the longest fleece. The Leicester sheep is especially valuable to stock breeders for crossing with other sheep. It is the ancestor of most of the other long-wooled breeds of sheep. American ranchmen have also used the Cotswold in improving quality, crossing the rams with Merino ewes. Romney sheep, which originated in southeastern England, are popular in New Zealand and in Oregon and California.

Crossbred-Wooled Sheep. Crossing two or more of the accepted domestic breeds to produce a new breed has become very common in developing modern types of sheep. Except for the Merino and Rambouillet types, probably all modern breeds are the result of such crossing. The *Corriedale* is a cross-bred sheep that has become popular throughout Australia, New Zealand, South America, and the United States. In the Corriedale, the breeders have attempted to combine the maximum wool and mutton production, to develop what is known as the dual purpose sheep. The Corriedale was bred from fine-wool and long-wool sheep in Australia and New Zealand. The breed was first imported into the United States in 1914. Similar crosses have also been made. They have resulted in the *Columbia*, *Romeldale*, *Panama*, *Montadale*, *Polwarth*, and *Targhee* breeds.

Medium-Wooled Sheep. These sheep are grown primarily for the meat they produce, but they also are a source of wool. The most important breeds are the *Hampshire*, *Shropshire*, *Southdown*, and *Suffolk*. Most farmers raise these sheep as purebreds. But in the West, they are used for breeding with the ewes of native sheep in order to produce lambs for the market.

The Shropshires are extremely popular on farms. Together with the Hampshire and Southdown, they are largely raised east of the Missouri River. The Hampshire and the Suffolk are extremely popular west of the Missouri. These breeds came from England. The face, ears, and legs of the Hampshire range in color from dark brown to black. The black face, ears, and legs of the Suffolk contrast sharply with its white wool body. The Southdown is a rather small sheep with a square-shaped body. The *Dorset* sheep is raised along the Atlantic Coast. This breed produces lambs at any season, and therefore is valuable for producing lambs for the winter market. Other important medium-wool breeds are the *Cheviot*, *No-Tail*, *Oxford*, *Tunis*, and *Ryeland*.

Coarse-Wooled Sheep. *Karakul* lambs have a glossy fur that is used to make women's fur coats. Lambs are usually killed and pelted when they are 3 to 10 days old, when the fur is most valuable. The *Scottish Blackface*, called *Blackface Highland* in the United States, produces a wool that is valuable for tweeds, carpets, and mattresses. *Navajo* sheep also produce a coarse wool for rugs and blankets.

Raising Sheep

There are two distinctly different ways of raising sheep in the United States. The most important way is on the range. Here sheep are herded about in large bands containing from 1,000 to 2,000 or more sheep. The herds are moved about on large tracts of land which may be owned by the sheep owner, or may be leased from another owner or from the government. The sheep eat grass in the pasture.

The other important way of raising sheep is on farms. The farmer raises from thirty to a few hundred head of sheep. He keeps them in fenced pastures. During the

LEADING SHEEP-RAISING STATES

Number of sheep in the state in 1974

Source: *Sheep and Goats, January 1, 1974*, U.S. Department of Agriculture.

LEADING SHEEP-RAISING COUNTRIES

Number of sheep in the country in 1974

*Estimate.
Source: *Livestock and Meat*, June, 1974, U.S. Foreign Agriculture Service.

winter he feeds them grain and hay grown on the farm.

Throughout history, sheep have generally been raised in places that are far from cities and other thickly populated areas. There are two main reasons for this. Compared to most products, wool is very valuable in proportion to its bulk. Furthermore, it does not spoil. Therefore, it can be stored and shipped over long distances. In the second place, sheep tend to herd together, and therefore they can be handled in large bands in open country with very little labor. Sheep like to eat woods and shrubs. They can live without water for long periods of time. This permits farmers to raise sheep on dry plains all over the world.

In the United States, most sheep are raised west of the Mississippi. Wool sheep predominate in the West, in Ohio, and in a few other sections. Mutton sheep are raised in practically all parts of the country. The United States can produce nearly all the lamb and mutton it needs. But it imports much of the wool it uses, because of the demand for special types of wool.

Enemies of Sheep

Sheep are attacked by various parasites and diseases. Foot rot and sore mouth are common diseases. Sheep suffer from internal parasites, and also from a disease called *sheep scab* caused by mites and ticks. Meat-eating wild animals often attack sheep, and dogs sometimes kill sheep. The kea parrot of New Zealand sinks its sharp, hooked bill into the sheep's back and eats the sheep's flesh and fat.

Scientific Classification. Sheep, together with cattle, goats, and buffaloes, belong to the bovid family, *Bovidae*. The urial sheep is genus *Ovis*, species *O. vignei*. The mouflon sheep is *O. musimon*. Domesticated sheep are genus *Ovis*, species *O. aries*. TONY J. CUNHA

Related Articles in WORLD BOOK include:

Animal (color pictures: Animals of the Mountains)	Livestock
Argentina (picture)	Mange
Australia (Agriculture; picture)	Mutton
Bighorn	New Zealand (pictures)
Foot-and-Mouth Disease	Ranching
Great Britain (picture)	Roquefort
Karakul	Ruminant
Lamb	Uruguay (picture)
Lanolin	Wool

SHEEP DOG. Almost everywhere that sheep have been raised, a type of dog has been developed to herd and watch the sheep. The dogs turn wandering sheep back to the flock, and keep the flock together. They also defend the flock from attacks by wolves and other animals. Sheep dogs are loyal, gentle, and intelligent.

The American Kennel Club recognizes 10 breeds of sheep dogs. They are (1) *Belgian sheep dog*, (2) *Briard*, (3) *collie*, (4) *German shepherd dog*, (5) *Great Pyrenees*, (6) *komondor*, (7) *old English sheep dog*, (8) *puli*, (9) *Shetland sheep dog*, and (10) *schnauzer* (*standard*). See the articles on these breeds in WORLD BOOK. Many countries have breeds not recognized in the U.S. OLGA DAKAN

See also DOG (color picture: Working Dogs).

SHEFFIELD (pop. 513,310) is a city in Yorkshire, England. It lies about 160 miles (257 kilometers) northwest of London on wooded slopes overlooking the Sheaf and Don rivers. For location, see GREAT BRITAIN (political map). The city is the home of Sheffield University, which was founded in 1905. German bombers damaged the medieval Cathedral of Saints Peter and Paul during World War II, but it was later repaired.

The city has been known for its fine cutlery since the 1300's. Candlesticks and teapots of *Sheffield plate* (silver on copper) are treasured possessions. During World War II, Sheffield's steel foundries and mills made armor plate and weapons. FREDERICK G. MARCHAM

SHEHAN, LAWRENCE JOSEPH CARDINAL (1898-), is an American religious leader. He was named a cardinal of the Roman Catholic Church in 1965 by Pope Paul VI. He also received the honorary title of primate of the United States because his Baltimore diocese is the oldest in the country. Cardinal Shehan was ordained a priest in 1922, and served at St. Patrick's Church in Washington, D.C., from 1923 to 1941. He became a bishop in 1945 and was appointed first bishop of Bridgeport, Conn., in 1953. He served as archbishop of Baltimore from 1961 until he resigned in 1974. Cardinal Shehan was born in Baltimore. THOMAS P. NEILL

SHEIK, *sheek*, or *shayk*, is an Arabic title referring either to an old and respected man or to the chief of a tribe or village. Sometimes a sheik is a religious leader. Only Moslems use the title of sheik. A sheik's power usually depends upon his own will and character. Songs and stories have pictured the sheik as a romantic figure.

SHEKEL, *SHEK ul*, is an ancient term that meant a unit of weight. Later it was used to mean a gold or silver coin. The shekel was used as a weight by the Babylonians, Phoenicians, and Hebrews. The Bible often refers to the Hebrew shekel. It weighed about 218 grains, or about $\frac{1}{2}$ ounce (14 grams). It was first used as money in the form of uncoined gold and silver. The Hebrews coined their first metal money about 139-138 B.C. Half and quarter silver shekels also were coined. Today, the word *shekel* is a slang term referring to money. FRED REINFELD

SHELBURNE MUSEUM. See VERMONT (Places to Visit).

SHELBY, ISAAC. See KENTUCKY (History).

SHELDRAKE. See MERGANSER.

SHELEPIN, *shel YEH pihn*, **ALEXANDER NIKOLAEVICH** (1918-), is a Russian Communist Party and government official. He became a member of a powerful body in the party, the Central Committee, in 1952, and served on the committee's 11-man Secretariat from 1961 to 1967. In 1964, Shelepin was named to the Presidium of the Supreme Soviet, the executive committee of the Russian legislature. He served on the Politburo, the policy-making body of the Russian Communist Party, from 1964 to 1975. Shelepin was born in Voronezh, Russia. WALTER C. CLEMENS, JR.

SHELEST, *shel YEST*, **PETER YEFIMOVICH** (1908-), is a Russian Communist Party official. He served as a member of the policy-making Politburo of the Communist Party's Central Committee from 1964 to 1973.

Shelest was born in Andriivets, the Ukraine. He held jobs as a farm, railroad, and factory worker before becoming a party official. Shelest joined the Communist Party in 1928. He served as first secretary of the Ukrainian Communist Party from 1963 to 1972. In 1972, he was appointed to the less important position of deputy premier of the Soviet Union. WALTER C. CLEMENS, JR.

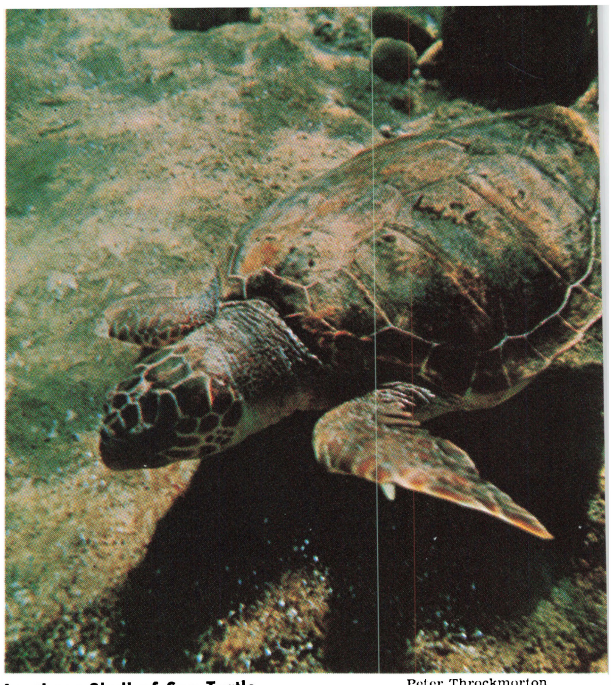
SHELL is a projectile. See AMMUNITION.

Walter Dawn

Coiled Shell of Land Snail

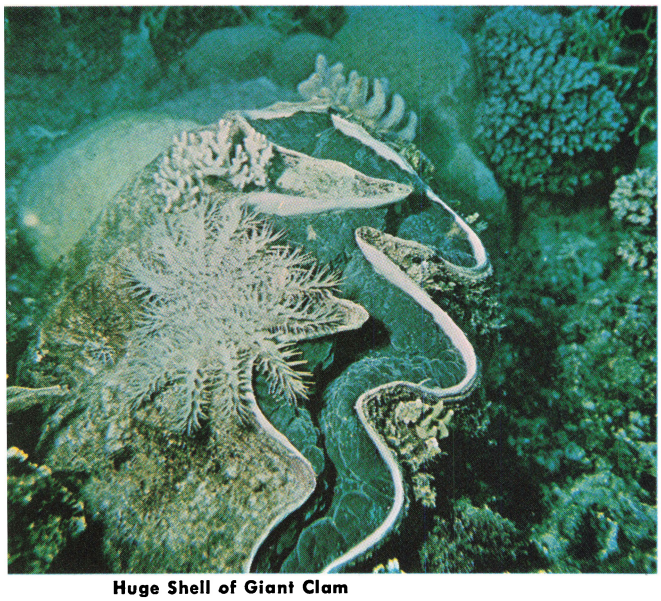
John H. Gerard

Brittle Bird's Egg Shells



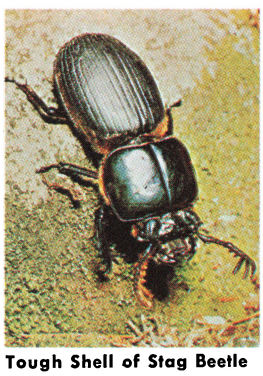
Peter Throckmorton from Nancy Palmer

Leathery Shell of Sea Turtle



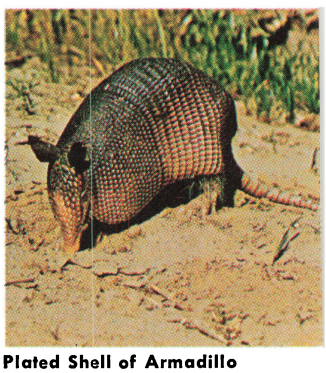
Ben Cropp, Keystone

Huge Shell of Giant Clam



Walter Dawn

Tough Shell of Stag Beetle



Leonard Lee Rue, NAS

Plated Shell of Armadillo

SHELL

SHELL. Many kinds of animals and plants have shells. Clams, lobsters, oysters, shrimps, snails, and turtles all grow shells. Shells also hold the seeds and nuts of the coconut, peach, walnut, and other plants.

Most shells grow on the outside of an animal or plant. These shells are like strong suits of armor that protect the bodies they cover. Some shells grow inside the bodies of cuttlefish and many kinds of squids. These shells, called *cuttlebones* in cuttlefish or *pens* in squids, help support the bodies of the animals.

Some kinds of shells have beautiful shapes and bright colors. Others are plain and colorless. Among the smallest kinds are the shells of the Vitrinellid, a sea snail found in many parts of the world. Some Vitrinellid shells grow only about as big as a grain of sand. The largest shell is that of the giant clam of the South Pacific Ocean. Its shell may measure 4 feet (1.2 meters) long and weigh 500 pounds (230 kilograms).

Some kinds of animals begin their lives inside egg shells. Thin, brittle shells cover the eggs of birds. Thick, leathery shells protect the eggs of alligators, snakes, and many other reptiles. Strong, rubbery shells hold the eggs of the platypus and echidna. Many other animals spend all their lives in shells that are important parts of their bodies. The shells of clams and oysters are really the skeletons of these animals. The shells of turtles and tortoises include part of their backbone and ribs.

Many persons collect shells as a hobby. Most shells in these collections belong to *mollusks*, a group of animals that includes clams, conchs, cowries, oysters, and snails. This article provides general information about mollusk shells. For information about the animals that grow these shells, see the separate World Book article on Mollusk and its list of Related Articles. For information about other kinds of shells, see the World Book articles on Egg and Seed, and articles on individual plants and animals, such as Walnut and Turtle.

R. Tucker Abbott, the contributor of this article, holds the du Pont Chair of Malacology at the Delaware Museum of Natural History. He is the author of American Seashells *and* Sea Shells of the World.

SHELL/*How Shells Are Formed*

There are about 100,000 kinds of mollusk shells. Each kind has its own special design and shape, but all are formed in much the same way. Some mollusks that grow the shells live in the ocean, some in fresh water, and others on land.

Most shells consist of three layers—an outer, middle, and inner layer. These layers are also called the *prismatic layer* (outer layer), the *lamellar layer* (middle layer), and the *nacreous layer* (inner layer). Each layer contains a form of calcium carbonate, a kind of limestone also found in marble and other kinds of rocks. In most shells, the mineral in these layers provides a hard covering for the shell. In the outer layer, the mineral may be in the form of small particles called *prisms*. In the inner layer, the mineral is often produced as a smooth, shiny substance called *nacre* or *mother-of-pearl*. The nacre of certain kinds of shells, including those of clams and scallops, has a dull appearance.

The food eaten by a mollusk provides the minerals that form the shell and give it color. The blood stream of the animal carries the minerals to the *mantle*, a fleshy skinlike tissue inside the shell. Special glands in the mantle produce the substances that make the shell in the form of a liquid. Other glands in the mantle add a hardening material so that the liquid quickly becomes firm and strong. Still other glands produce the color. The pattern of the color depends on (1) whether color is added continuously, and (2) the number of places in the mantle from which color is added. For example, if color is added continuously from only one place in the mantle, the shell will have one stripe. If color is added continuously from four places, the shell will have four stripes. If the color flow is interrupted from time to time, spots or bars will form on the shell.

Most kinds of mollusks add material to their shells throughout their lives. As long as the animal grows, its shell also grows. Clams and snails begin to grow shells before they hatch. After they leave the egg, their bodies rapidly increase in size. A sea snail that is only $\frac{1}{10}$ inch (3 millimeters) long when it hatches may grow 5 or 6 inches (13 or 15 centimeters) in six months. Most clams and sea snails grow for about six years.

SHELL/*Kinds of Mollusk Shells*

Mollusk shells can be divided into five main groups, each with a common name and a scientific name. These groups are (1) univalves or *Gastropoda*, (2) bivalves or *Pelecypoda*, (3) tooth shells or *Scaphopoda*, (4) octopuses and squids or *Cephalopoda*, and (5) chitons or *Amphineura*. A sixth group, the *Monoplacophora*, is extremely rare. Scientists have found these shells only as fossils or in the deepest waters of the Pacific Ocean.

Univalves. The word *univalve* means *one shell*. Snail shells are univalves. Most snails have a tubelike shell that winds around itself as it grows. The soft body of the snail is in the open part of the tube. Most snail shells grow by winding to the right in a clockwise direction, and are called *right-handed shells*. A few kinds of snails have *left-handed shells*.

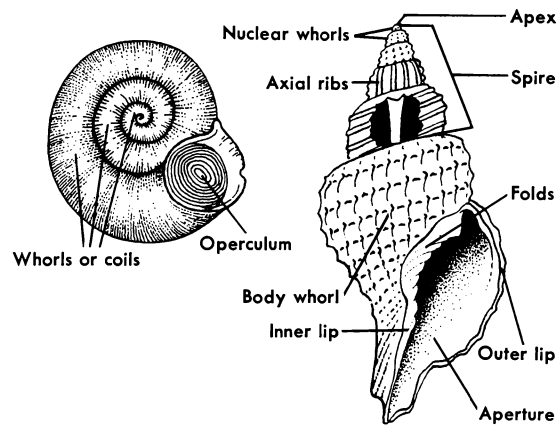
The shells of univalves have an opening at one end. Most of them have a hard lidlike part called an *operculum* at the opening. The animal can pull the operculum over the entrance of the shell to keep out such enemies as fish and crabs.

Univalves are found in almost every part of the world except on the highest mountain peaks. Some live in the ocean, some in fresh water, and some on land. Many ocean univalves have smooth, glossy shells. Others have shells with deep ridges, rough surfaces, and long, sharp spines. The carrier shell snail attaches bits of shells, stones, and other objects to its soft shell substance as it grows. The shell substance acts as cement, and when the shell hardens, the objects are held firmly in place. Most univalves that live in fresh water or on land have thin, smooth shells. Many tree snails, particularly those of the tropics, have brightly colored shells.

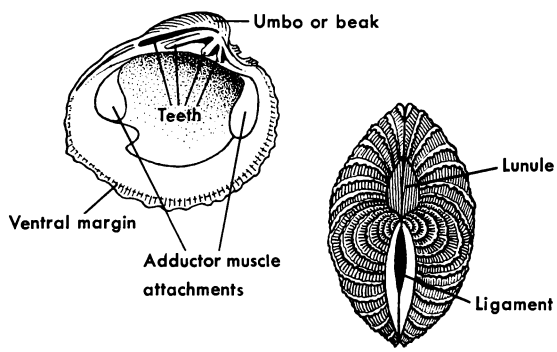
Limpet shells are also univalves. These shells grow almost flat and form a point in the center. The shells of keyhole limpets have a hole at the top, and look like miniature volcanoes.

Scientists have identified more than 60,000 species of

THE PARTS OF A UNIVALVE SHELL



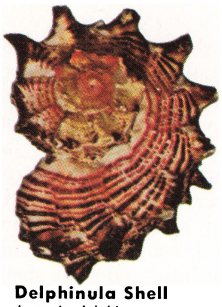
THE PARTS OF A BIVALVE SHELL



WORLD BOOK illustration by Tom Dolan

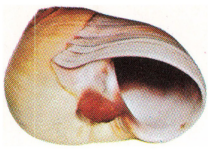
UNIVALVE SHELLS

Commercial Top Shell
Trochus niloticus
Indian and S.W. Pacific Oceans
$\frac{1}{3}$ actual size



Delphinula Shell
Angaria delphinus
S.W. Pacific Ocean
Actual size

Oriente Tree Snail
Polymita picta
Cuba
Actual size



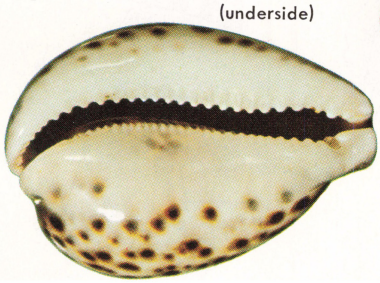
Eastern Moon Snail
Polinices duplicatus
U.S. Atlantic Coast
$\frac{1}{2}$ actual size

Limpet
Patella lugubris
Azores
$\frac{2}{3}$ actual size

(top)

Tiger Cowrie
Cypraea tigris
Indian and S.W. Pacific Oceans
$\frac{1}{2}$ actual size

(underside)



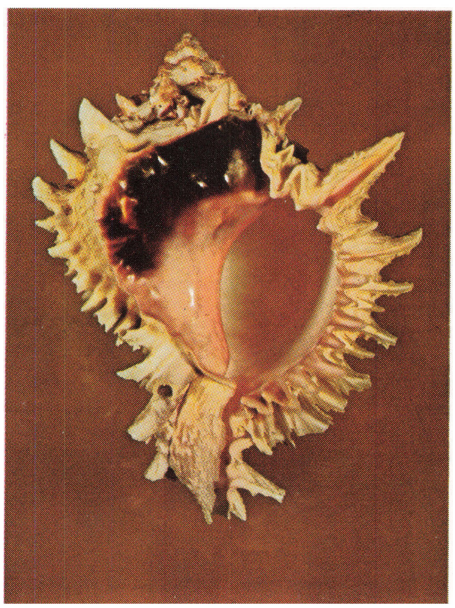
Carrier Shell
Xenophora neozelanica
New Zealand Coast
$\frac{1}{2}$ actual size

Tent Olive Shell
Oliva porphyria
Pacific Coast of Panama
$\frac{1}{2}$ actual size

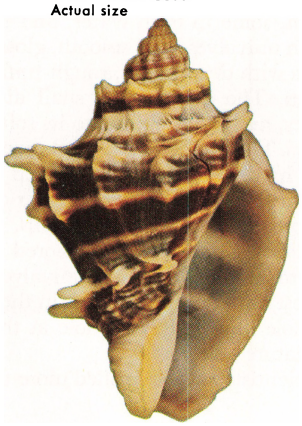
Left-Handed Whelk
Busycon contrarium
U.S. Atlantic Coast
$\frac{1}{2}$ actual size

Regal Murex
Murex regius
Pacific Coast, Mexico to Panama
$\frac{1}{2}$ actual size

Textile Cone
Conus textile
Indian and S.W. Pacific Oceans
$\frac{2}{3}$ actual size

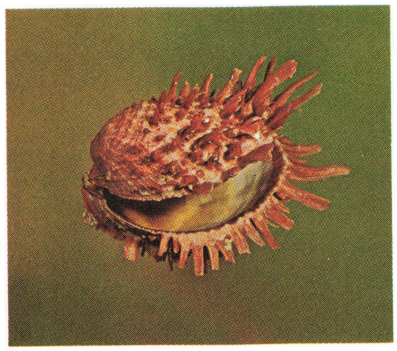


Crown Conch
Melongena corona
West Florida Coast
Actual size



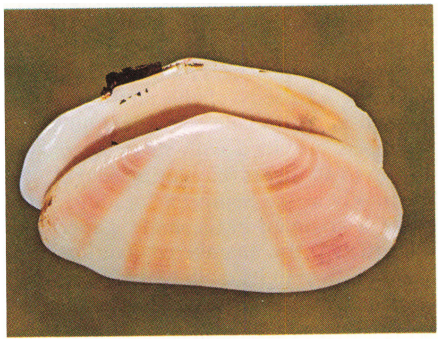
BIVALVE SHELLS

Fragile River Mussel
Leptodea fragilis
Fox River, Illinois
$\frac{1}{2}$ actual size



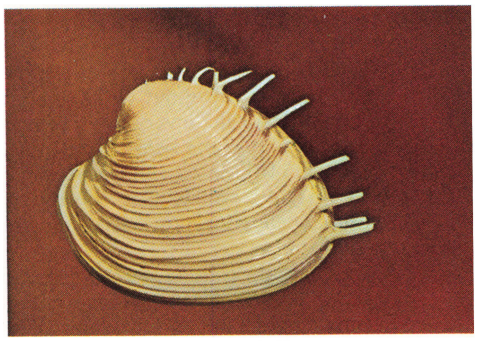
Pacific Thorny Oyster
Spondylus pictorum
Pacific Coast of Mexico
$\frac{1}{3}$ actual size

Mantle Scallop
Gloripallium pallium
S.W. Pacific Ocean
$\frac{1}{2}$ actual size



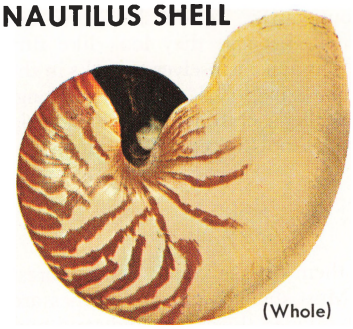
Sunrise Tellin
Tellina radiata
West Indies
$\frac{2}{3}$ actual size

Blue Mussel
Mytilus edulis
North Atlantic Ocean
$\frac{1}{2}$ actual size



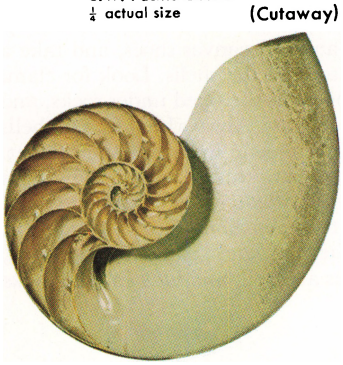
Royal Comb Venus
Pitar dione
Caribbean Sea
$\frac{2}{3}$ actual size

NAUTILUS SHELL



Chambered Nautilus
Nautilus pompilius
S.W. Pacific Ocean
$\frac{1}{4}$ actual size

(Cutaway)



CHITON SHELL

West Indian Chiton
Chiton tuberculata
West Indies
$\frac{2}{3}$ actual size

TOOTH SHELL

Elephant's Tusk Shell
Dentalium elephantinum
Japan and Philippine Islands
Actual size

WORLD BOOK photos; specimens courtesy the Academy of Natural Sciences of Philadelphia and Albert Lindar.

univalve shells. The largest are the horse conch of Florida and the baler of Australia. Both grow about 2 feet (61 centimeters) long. The giant African snail has a larger shell than any other land snail. It is about 8 inches (20 centimeters) long. Many univalves have shells so small they can hardly be seen. For example, a row of 30 Barlia snail shells measures less than 1 inch (2.5 centimeters) long.

Bivalves have two matching shells. The shells move on hinges that look like small teeth. Clams, oysters, and scallops are bivalves. Bivalves keep their shells open when resting and undisturbed. A broad band of elastic tissue acts like a prop to hold the shells apart. If an enemy comes near, a strong *adductor* muscle attached to both shells snaps the shells shut and keeps them closed. If the muscle gets tired and relaxes, the shells open again. An enemy usually does not wait this long.

Bivalves are found almost everywhere except on dry land. There are about 11,000 kinds of bivalves. Most of them live in shallow ocean waters near land, but a few species live in the beds of large rivers. Perhaps the best known of these are the fresh-water clams of the Mississippi River valley. Occasionally, a pearl is found in these shells. But most pearls valued as gems come from the pearl oyster of the sea.

The giant clam of the South Pacific, whose shell may grow 4 feet (1.2 meters) long, is the largest bivalve. The smallest include turton clams of the North Atlantic. They grow about half as large as a grain of rice.

Tooth Shells look like long needles or like miniature elephant tusks. They are sometimes called *tusk shells*. The shells are hollow tubes that curve slightly and become smaller at one end. Both ends are open.

Tooth shells are found in the sand or mud of the ocean bottom in many parts of the world. Some kinds live close to shore. Others burrow in the ocean floor far below the surface of the water. The small end of the shell sticks up into the water.

Scientists have identified about 500 kinds of tooth shells. The shells vary in length from $\frac{1}{2}$ to 5 inches (1.3 to 13 centimeters). Most of them are white, but some have green, red, or yellow tints. The most colorful tooth shell is the elephant's tusk of the Philippines, which is dark green with bluish ribs.

Octopuses and Squids. In this group of sea animals, the cuttlefish and squids have shells inside their bodies. The cuttlefish, also called the Sepia squid, has a chalky cuttlebone inside its body. This shell is light and spongy, but it serves as a strong support for the animal's body. The Spirula squid has a shell about 1 inch (2.5 centimeters) long under the skin at the rear of its body. The tightly coiled Spirula shell looks somewhat like a ram's horn. In tropical countries, waves often wash these curled shells ashore. Octopuses have no shells.

Perhaps the best-known shell of this group is the chambered nautilus, also called the pearly nautilus. It consists of a series of inside chambers, each larger than the one before. Thin walls seal off every chamber except the outer one, where the soft body of the nautilus is found. The coiled shell is cream colored with brown stripes, and the chambers are lined with shiny pearl. Nautilus shells grow up to 10 inches (25 centimeters) in diameter. They live mostly in the South Pacific.

The paper nautilus or argonaut has a single, paper-thin shell much like that of the chambered nautilus. The paper nautilus never lives in its shell, which serves only as an egg case and nest. The female builds the thin, fragile shell, and carries it about until the eggs hatch. Then she lets it float away. The paper nautilus lives at the surface of warm tropical seas.

Chitons. A chiton shell consists of eight separate, movable pieces called *plates* that are held together by a leathery *girdle* (belt). The girdle acts like a series of hinges between the plates and allows the animal to bend and move about easily. Chiton shells are also called coat-of-mail shells because they look like tiny suits of armor. Chitons attach themselves to rocks in the sea. Some are less than 1 inch (2.5 centimeters) long. The largest chiton, Steller's chiton of the California coast, grows up to about 1 foot (30 centimeters) long.

SHELL/*Collecting Shells*

Many persons find shell collecting a fascinating hobby. They spend leisure time hunting and cleaning shells, and mounting them in attractive displays. Some collectors become so interested in their hobby that they begin the scientific study of shells, which is called *conchology*. Hundreds of amateur and professional shell collectors exchange ideas, information, and shells through shell clubs in cities in almost every country.

Beginning collectors gather all the shells they can find, even broken and discolored ones. Serious collectors replace poor shells with those of the finest quality as soon as they can. The best quality of shells are *live shells* —those taken with the live animal still inside. These shells have their natural color and luster because they have not been bleached by the sun or scratched by the sand. However, some cone snails of the Indian and southwest Pacific oceans have a poisonous sting. The next best quality are *recently dead shells*. Storm waves or outgoing tides leave them on the beach. The poorest shells are *dead shells*. Most shells found on beaches are dead shells. The sun has faded the colors, and sand and water have dulled the luster.

Searching for Shells. You can find the best sea shells during the night or in the early morning hours at low tide. Use a strong flashlight or lantern to light your way. Wear a bathing suit and soft canvas shoes, and take a small bag or bucket to hold the shells. Look for clams buried in the sand, for snails sheltered under rocks, and for scallops hiding in eelgrass. Always hunt for sea shells with a companion who can help in case of an accident.

Many kinds of fresh-water mussels and snail shells can be found in rivers, streams, lakes, ditches, and ponds. Use a dip net to sweep along the grassy edges of ponds. To find the shells of land snails, roll logs over, scrape away the leaves and soil, and look in the cracks of the bark.

As you gather shells, write down the date and the exact location where you find each one. Keep these notes with the shells until you add them to your collection. Then put the information on labels that identify the shells.

Cleaning Shells. The best and simplest way to clean live mollusk shells is to boil them. Put the shells in a pan of water, bring the water slowly to a boil, and boil for 5 to 10 minutes. Then let the water cool slowly. The meat of the clams will fall out. Use a twisted safety pin to pull out snail meat. Save the snail's operculum because it is part of the shell. Wash the shells with soap and water, and place them on paper to dry in the sun. Very small live shells can be soaked in alcohol for several days, and then dried in the sun.

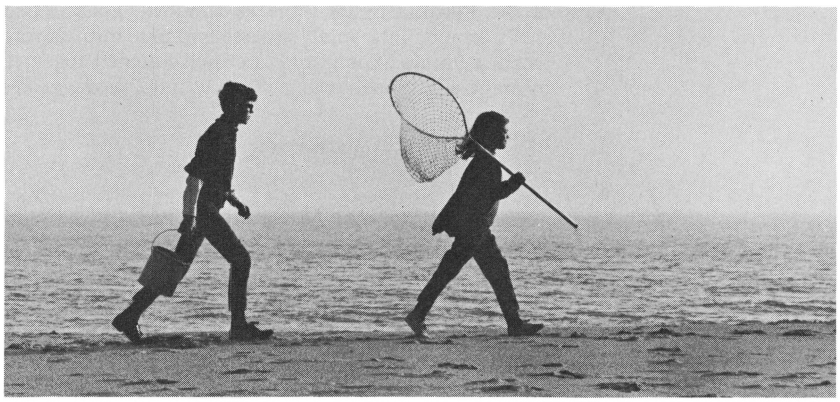
Displaying Shells. You can mount your shells on cardboard, or you can put them on cotton in flat boxes with glass or plastic covers. Some collectors use a cabinet with large drawers to store their shells. A square cardboard tray holds each kind of shell. A label bears the name of the shell and tells where, when, and by whom it was collected. The label also gives information about the shell's surroundings, such as grass, mud, sand, or depth of water. A logbook serves as an index to the shells in the collection and gives further information about them.

Every part of a shell helps identify it. For example, the number and location of the teeth in a shell hinge show that the mollusk belongs to a certain family of clams. The color, ridges, and shape of a snail shell identify the group to which it belongs. Each part of a shell has a special name, such as lip, ribs, or shoulders. Drawings with this article show the parts of shells and name them.

A shell collection should be arranged so that it begins with the shells of the simplest kinds of mollusks. Many shells have popular names, such as mouse cone or Florida cone. These names may vary from one country to another, and even from one area to another. For this reason, collectors identify shells by their scientific names. These names are in Latin and are understood in all parts of the world. The Latin name of the mouse cone is *Conus mus*, and that of the Florida cone is *Conus floridanus*.

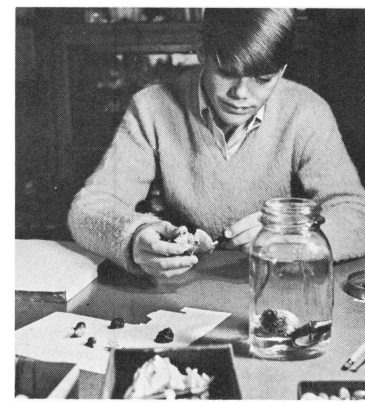
PREPARING A SHELL COLLECTION

Most shell collectors like to find and prepare their own shells. They hunt for shells along the shores of oceans, lakes, or rivers. Then they clean the shells, identify and label them, and arrange them in attractive displays. Some collectors buy special shells for their collections.



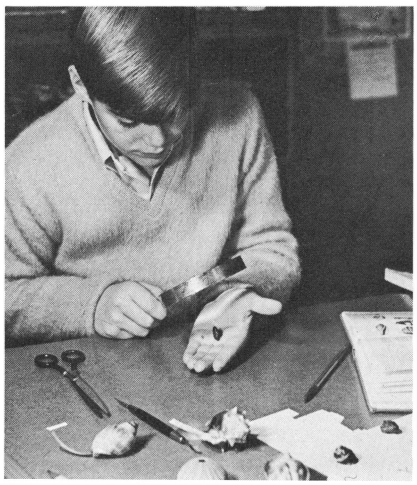
A Shell-Collecting Expedition

WORLD BOOK photos by Don Stebbing



Cleaning the Shells

Identifying the Day's Catch

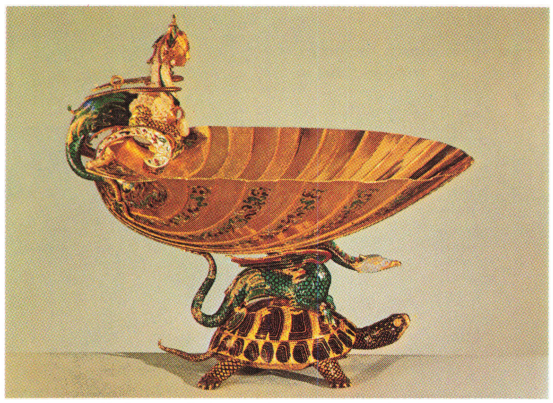


Labeling the Shells

An Interesting Shell Display

"Madonna of the Sea," courtesy of Edward Waldo Forbes, Director Emeritus, Fogg Art Museum, Cambridge, Mass.

Shell Mosaic, by Edward Waldo Forbes and associates, is made from pieces of clam shells carefully fitted to form the design.

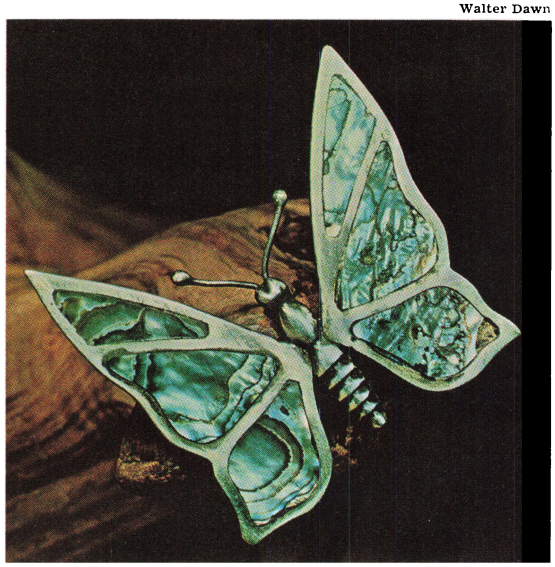


The Metropolitan Museum of Art, New York. Bequest of Benjamin Altman, 1913.

A Graceful Shell, *above,* provides the basic design of the famous Rospigliosi cup by the artist Benvenuto Cellini.

A Butterfly Pin, *below,* combines gleaming mother-of-pearl with silver to make the insect's colorful wings.

Walter Dawn



SHELL / *Uses of Shells*

The color and luster of shells make them especially useful as decorations and for jewelry. Manufacturers cut the shells of fresh-water mussels to make pearl buttons. Craftsmen use mother-of-pearl from abalone and oyster shells to decorate fancy boxes, jewelry, and musical instruments. Artists carve raised designs called *cameos* in many kinds of shells to make ornamental pins and other kinds of jewelry. Conchs and some other large shells can be polished and used as lamp bases or paperweights. Many kinds of small shells are fastened together in the shape of animals or dolls, or to form attractive designs.

Scientists sometimes use shells to help them in their work. Atomic scientists may expose shells to atomic rays to test the effects of radiation. Oil prospectors search for certain kinds of fossil shells in deserts and prairies. The shells show that the area was an ocean bed in ancient times. Large oil pools formed in many of these ancient ocean beds.

In prehistoric times, cowrie shells and tooth shells were used as money. The Phoenicians and Romans made a purple dye from Murex sea snails. They believed that cloth colored with this dye was more valuable than gold.

The Indians of North and South America also used shells as money. North American Indians carved wampum beads from large clam shells and parts of the knobbed whelk of the Atlantic Coast.

In the Philippines, the thin, almost transparent shells of the Placuna oyster serve as window "glass." The shells are cut into small squares and put into narrow wooden frames. The frames are then fastened together to make a large window.

R. Tucker Abbott

SHELL / *Study Aids*

Related Articles. See Mollusk with its list of Related Articles. See also the following articles:

Armadillo	Fossil	Pearl
Button	Mother-of-Pearl	Turtle
Crustacean	Nummulite	Wampum

Outline

I. How Shells Are Formed
II. Kinds of Mollusk Shells
- A. Univalves
- B. Bivalves
- C. Tooth Shells
- D. Octopuses and Squids
- E. Chitons

III. Collecting Shells
- A. Searching for Shells
- B. Cleaning Shells
- C. Displaying Shells

IV. Uses of Shells

Questions

What is a univalve shell?
When are the best times to hunt for sea shells?
What is the largest shell?
How many layers do most mollusk shells have?
What is *conchology?*
When do clams and snails begin to grow shells?
Where do mollusks get the minerals for their shells?
What do keyhole limpet shells look like?
Why are tooth shells sometimes called *tusk shells?*
How does the paper nautilus use its shell?

SHELLABARGER, SAMUEL (1888-1954), a popular novelist, won success as a writer when he published *Captain from Castile*, a historical romance, in 1945. He had been a professional educator, and had published a number of romances and detective stories before then. His other literary works include *Prince of Foxes* (1947), *The King's Cavalier* (1950), and *Lord Vanity* (1953). Shellabarger was born in Washington, D.C. He wrote several of his earlier works under the pen names of John Esteven and Peter Loring. BERNARD DUFFEY

SHELLAC, *shuh LACK*, is the liquid formed of resin flakes which have been dissolved in alcohol. It is used as a varnish. The flakes are the dried form of a sticky substance called *lac resin* (see LAC). When shellac is applied to a surface, the alcohol in the solution evaporates, leaving a shiny finish. Shellac resin flakes are yellow, orange, or reddish, but can be bleached white. Shellac is also used in sealing wax, insulating materials, phonograph records, and as a stiffener. GEORGE L. BUSH

See also LACQUER; RESIN; VARNISH.

SHELLEY, MARY WOLLSTONECRAFT (1797-1851), an English author, wrote the famous horror novel *Frankenstein* (1818). She was born in London, the daughter of philosopher William Godwin. When she was 16, she met the poet Percy Bysshe Shelley. Although Shelley was married, Mary ran away with him. They were married after Shelley's first wife died in 1816, and settled in Lerici, Italy. Mary wrote *Frankenstein* there at the suggestion of her husband and the poet Lord Byron. Shelley drowned near Leghorn, Italy, in 1822.

Shelley's death changed Mary's life from one of adventure and excitement to one of loneliness and failure. She wrote a few novels after her husband's death, including the autobiographical *Lodore* (1835). But she was forced to write much low-quality material to support herself and her children. JAMES DOUGLAS MERRITT

See also FRANKENSTEIN; SHELLEY, PERCY BYSSHE; GODWIN.

SHELLEY, PERCY BYSSHE (1792-1822), was one of the great English lyric poets. He experimented with many literary styles and had a lasting influence on many later writers, particularly Robert Browning, Algernon Charles Swinburne, William Butler Yeats, George Bernard Shaw, and Thomas Hardy.

His Life. Shelley was born on Aug. 4, 1792, in Sussex into a wealthy and politically prominent family. He had a stormy career at Eton College and Oxford University, from which he was expelled in 1811 for writing a pamphlet called *The Necessity of Atheism*.

In August, 1811, Shelley eloped with 16-year-old Harriet Westbrook, the daughter of a former coffeehouse owner. He abandoned her in 1814 and ran away with Mary Wollstonecraft Godwin. Although both said they did not believe in marriage, Shelley and Mary Godwin were married in 1816, after Harriet drowned herself. See SHELLEY, MARY WOLLSTONECRAFT.

Shelley believed the Irish were being oppressed by their English rulers, and tried to rouse the Irish to rebel against England. He wrote *Queen Mab* (1812-1813), a revolutionary poem which attacked both political tyranny and orthodox Christianity. In 1816, Shelley and his wife formed a close friendship with the poet Lord Byron in Geneva, Switzerland. After March, 1818, Shelley went into permanent exile in Italy. There he wrote a sequence of important poems, including *Prometheus Unbound* (1818-1819), *The Witch of Atlas* (1820), *Epipsychidion* (1821), and *Hellas* (1821). The death of an acquaintance, the English poet John Keats, inspired Shelley's important elegy *Adonais* (1821). On July 8, 1822, Shelley drowned during a storm while sailing near Leghorn, Italy.

Portrait by Amelia Curran; National Portrait Gallery, London

Percy Bysshe Shelley

His Writings. Shelley's poems are emotionally direct, but difficult to understand intellectually. Much of his poetry is autobiographical, including his most famous lyric "Ode to the West Wind" (1819). Shelley's spiritual attitudes were intensely personal and tended to oppose traditional Christian views. Shelley felt that spiritual truth was not based on either supernatural revelation or natural experience. Instead, he thought truth could be understood by the imagination alone. The role of the imagination as a spiritual guide is the subject of "Mont Blanc" (1816). This powerful meditative poem first revealed Shelley's mature style.

In his most ambitious long poem, the lyrical drama *Prometheus Unbound*, Shelley attempted to combine his imaginative faith with his hopes for mankind. Like much of Shelley's work, this play is based on classical Greek models. Prometheus, the creative power in Man, is liberated by Demogorgon, a mythical figure who stands for inevitable change in human events. At the end of the play, earthly rulers and government institutions are defeated, and love and beauty reign over mankind, but perhaps not forever.

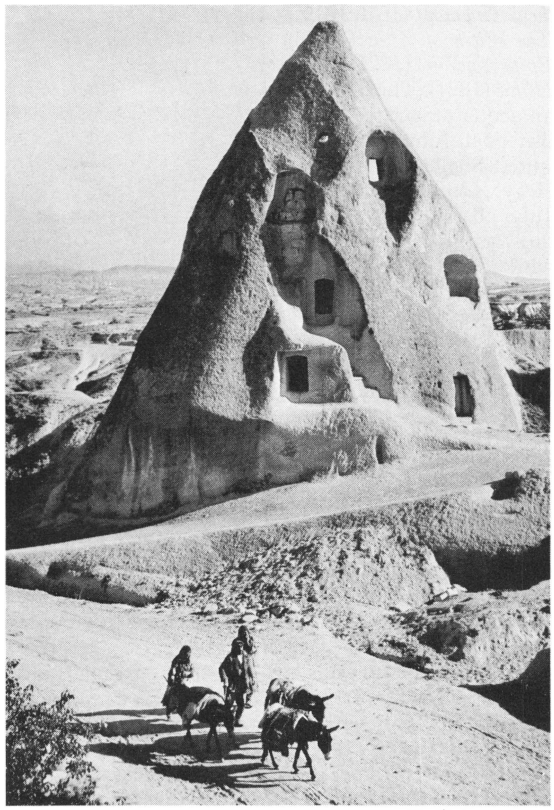
Shelley's poetry became somber after the revolutionary hope expressed in *Prometheus Unbound*. The Irish poet William Butler Yeats described Shelley's themes as an increasing conflict between infinite desire and the inability fully to realize such desire. *Epipsychidion* expresses Shelley's love for an Italian noblewoman, Emilia Viviani. This poem tries to achieve a vision of ideal love finding its lasting home in an earthly paradise. The poem ends in despair of its own quest.

In 1821, Shelley wrote his famous essay *A Defence of Poetry*. The work is valuable for its insights into every poet's general ideas and Shelley's views on the role of imagination in poetry.

Whether Shelley had begun to find some definite faith, philosophical or otherwise, we do not know, but his final poems are as grim and sorrowful as any he wrote. His final love lyrics are serene only in their hopelessness. According to his powerful unfinished poem on human defeat, *The Triumph of Life*, good and the means of accomplishing good cannot be reconciled. However grim his final vision, he always looks toward the hope of inspiration, as in the "Ode to the West Wind":

Scatter, as from an unextinguished hearth
Ashes and sparks, my words among mankind!
Be through my lips to unawakened earth
The trumpet of a prophecy! HAROLD BLOOM

SHELLFISH. See CRUSTACEAN; MOLLUSK.



Marc Riboud, Magnum

An Ancient "Skyscraper" still provides shelter for Turkish farmers. Early Christians hacked out the rooms in volcanic cones.

SHELTER is a place for protection. It is one of man's three most important needs. The others are food and clothing. Shelter protects man from wind and rain, and from the heat and cold. It shields him against insects and wild animals, and helps protect him from other dangers. Man could not live long without shelter, except in a few places where the climate is always mild.

Natural shelter, such as a cave, may provide protection from the weather. But man-made shelter, such as tents, houses, and apartments, provides comfortable homes for the enjoyment of family life.

Why All Shelters Are Not Alike

Three factors affect the kinds of shelter that men build: (1) the climate in which they live, (2) the kind of building materials they can use, and (3) the dangers that might threaten them.

Climate. People in hot, dry countries build houses with thick walls to keep out the heat. The walls have only a few narrow windows, or none at all, to prevent the sun's rays from pouring into the house. In many regions, if there is not much rain, the houses have flat roofs, where families can sleep in the cool night air.

People who live in rainy climates usually live in houses with steep, pointed roofs, so the rain will run off easily. They sometimes lay bundles of grasses, rushes, or leaves in rows on the roof, so that rain water runs off without leaking into the house. People also use thin strips of stone or wood called *shingles* to keep water out.

In Borneo, the Philippines, New Guinea, and India, people often build houses on stilts or high posts to protect them from dampness. The posts raise the house off the ground. In Borneo, the average home holds 40 to 50 families. The people of Borneo also live in one-family stilt houses. The side walls slant outward to join the peaked roofs.

Many people of snowy climates build strong, warm shelters to keep out the cold. They make their roofs strong so they will not fall in under the weight of heavy snows. They also slant the roofs steeply so the snow can slide off. The roofs usually hang far out over the sides of the houses. This keeps snow from piling up around the windows and doors.

In some countries, people need protection from high winds. They build their shelters low to the ground. On windy slopes in Switzerland, people pile heavy stones on their roofs to keep them from blowing away.

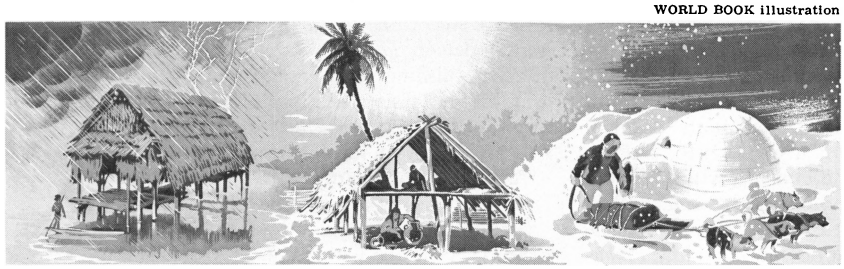
Materials. People usually build shelters with materials they can get easily. Eskimos, for example, live in regions that do not have forests. As a result, many Eskimos who live far from modern settlements do not have wooden houses. They still live in shelters called *igloos*. These dwellings include skin tents in summer and winter homes made of sod, stone, or blocks cut from packed snow (see IGLOO). In Mexico, and the southwestern United States, many people mix clay and dirt or mud with water to make *adobe*, or sun-dried bricks, for their thick walled homes (see ADOBE). Some people in India and other countries live in clay shelters.

In Northern Europe, wood is scarce and clay would melt away under the heavy rains. The people make their homes out of stone, which they find nearby.

In some parts of Africa, the grass grows as tall as a man's head, and is very strong. The people weave the grass into huts that look like wicker baskets turned upside down. One of these huts may be large enough for

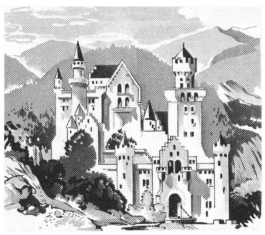
HOW CLIMATE AFFECTS SHELTER

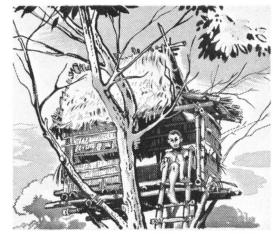
WORLD BOOK illustration



In wet climates, *far left*, a tight roof is needed to protect persons from rain. The house must be high where drainage is a problem. In warm climates, *center*, only a light shelter is needed for protection from sun and rain. In cold climates, *left*, the shelter's walls must be of a thick material to keep the inhabitants warm.

HOW SHELTER PROVIDES PROTECTION





WORLD BOOK illustration

Castles in the Middle Ages, *far left*, used moats and walls for protection. Pueblo Indians, *center*, built houses many stories high. They used ladders to reach upper floors and pulled them up to keep out enemies. Today, tree dwellers in the Philippines, *left*, use methods similar to those of the Pueblos.

only one person to sleep in. The people of many Pacific islands also weave strong stems of grass together for their shelters. The Sakai tribe of Malaya builds huts in the forked branches of trees for protection. These people make walls of thick stems called *rattan* and use palm leaves 6 to 10 feet (1.8 to 3 meters) long for the roof. The floor is made of bamboo poles. See RATTAN.

Dangers. In countries such as Japan, where earthquakes occur frequently, people make their homes of light materials. They are safer in such homes if an earthquake shakes down their shelters. Japanese homes have roofs of light bamboo sticks. The walls that separate the rooms are light sliding screens made of bamboo frames covered with paper. The houses usually have wooden frames, and walls of wood, slate, tile, or plaster.

Many people in New Guinea and other South Pacific islands build homes on stilts in the water of lakes and lagoons. They have little to fear from wild animals or human enemies. When these dangers threaten them, they pull up the bridges that connect their houses to the shore. For the same reason, some people in Borneo, the Philippines, and Malaya build tree houses that are reached by ladders which can be drawn up.

Shelter Around the World

In the United States, shelter varies widely according to income and surroundings. City families may live in apartments or houses. Farmers and most people in small towns live in houses. Wood, brick, stone, stucco, and concrete are the common building materials.

Most apartments consist of one, two, or three rooms. But some may be as large as a big private home. The building owner usually provides janitor service and heat. Rent may include the cost of gas, electricity, and telephone, or the tenant may pay for these separately.

The usual one-family house is one or two stories high. Often it has a basement and an attic. The living room is usually the largest room in the house. Many houses have central heating provided by coal, oil, or gas furnaces. The windows are fairly large and the ceilings rather low. Many modern homes are air-conditioned.

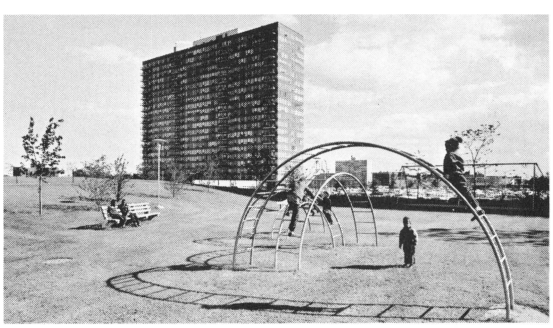
City houses usually have smaller yards than those in small towns or suburbs, because city land is scarce and costly. A farmer's house may vary little from a house in a small town or suburb. But it generally has a larger kitchen. Most farmhouses are comfortable structures of two or three stories, usually built of wood. More and more farm homes have bathrooms and electricity.

Houses and apartment buildings in the United States may be of any style of architecture. The style depends on tastes, climate, and local tradition. In New England, people often cover the outside walls of their houses with overlapping boards, called *clapboards*. These keep out cold winds. Clapboard houses are common in many parts of the United States.

In the South, many houses have no basements. Instead, the houses are set on brick or stone pillars 2 to 4 feet (61 to 120 centimeters) high. Air circulates beneath the floor and helps keep the house cool in summer.

Many persons in the Southwest build Spanish-type houses of stucco or adobe. Spacious rooms and cool patios make these houses pleasant. In many larger houses, rooms surround the patio, which usually has a fountain.

In Canada, there is a large lumber supply from the vast forest areas. Most of the houses are made of wood, but builders also use brick and stone. Some people in the north woods build log cabins. They build great stone fireplaces to keep the cabins warm during the cold winters, and stop the chinks in the logs with clay or grass to keep out the wind.



Stephen Lewellyn

A Glass-Enclosed Apartment Building provides shelter for Chicago children and their families. The structure stands in the Lake Meadows housing development.

Canadian Geographical Journal

Canadian Farm Buildings provide shelter for a farm family, their domestic animals, and harvested crops. The high-pitched roofs allow snow to slide off freely during the winter months.

In Latin America, homes show the influence of the early Spanish and Portuguese settlers. Like many homes in the southwestern United States, these homes are built of stucco or adobe, and have tiled roofs. Larger houses often have cool, comfortable patios. In Mexico, the people usually build thick walls of adobe.

Many huts in the South American jungles resemble those in other tropical countries that have much grass and trees. The people build these huts by making frames of tree branches and covering them with grass or leaves. The Tehuelche Indians, who live near the chilly Strait of Magellan, have shelters that serve chiefly as windbreaks. They build a semicircular frame out of tree branches and cover it with animal skins.

In Europe the people usually build wooden houses if forests grow nearby. Where there is clay, they make bricks for their homes. If there is no clay or forest, the people build stone houses.

The Scandinavian countries have plenty of lumber. The people there build colorful wooden houses, with large beams and attractive balconies. They carve decorations on the beams and paint them bright colors. Sometimes they plaster the outside walls of their homes and paint large pictures on them.

Farmers in southern Italy often use loose stones to build their houses. These round "beehive" shelters look like dome-shaped Eskimo igloos and often have walls 7 feet (2 meters) thick. The narrow windows let in only a little light. The farmers build their beds into the walls and make the floors of large, flat stones. In the Dordogne Valley of southern France, people still live in caves, as men did thousands of years ago. A dry cave can be comfortable in winter and summer.

German farmers usually build houses of wood or stone, depending on which material is more plentiful. They make roofs of tile, shingles, or straw. Thatched roofs are common in both Eastern and Western Europe.

Austrians who live in the Tyrolean Alps often build two-story houses with the upper floor extending out over the ground floor. They store their firewood under the overhanging floors. Usually they make the upper story of wood and the lower story of stucco or cement. In southern Austria, the farmers often decorate their stone houses with carved posts. Many farmers in northern Austria decorate the outside walls of their houses with paintings of religious scenes.

Most houses in Poland are one-story cottages, with large windows. Farmers in the Ukraine build adobe houses which they cover with thatched roofs. Many people in Russia build small houses of logs or rough lumber with straw-thatched roofs.

In Asia. People usually build shelter on land, but thousands of Chinese live in houseboats on the rivers of central and southern China. These boats are only about 20 feet (6 meters) long, but entire families live on them all their lives. Parents tie ropes around children to keep them from falling overboard.

Most Chinese live in houses made of brick, tile, adobe, or bamboo. The country has no large forest areas. The people generally make roofs of tile and floors of wood or tile, or simply the ground itself.

Some Chinese houses have a wall around them, with a shorter wall inside the entrance gate. Visitors go through the entrance gate, then must walk around the shorter wall before entering the house. Many Chinese once believed that this kept out evil spirits. An old Chinese belief held that spirits cannot go around a corner.

In Tibet, many people live in tentlike structures called *yurts*. They make these dwellings by covering a framework of tree branches with felt. Wool for felt comes from the yak, a long-haired animal that looks somewhat like a cow. The felt-covered shelters keep the people warm during the cold winters.

The stilt houses of Borneo, the Philippines, and India sometimes have running water. Water flows to the houses through bamboo pipes from nearby hillside springs. Under the houses, the people build fences between the stilts, and keep their animals in the enclosures to protect them from wild beasts.

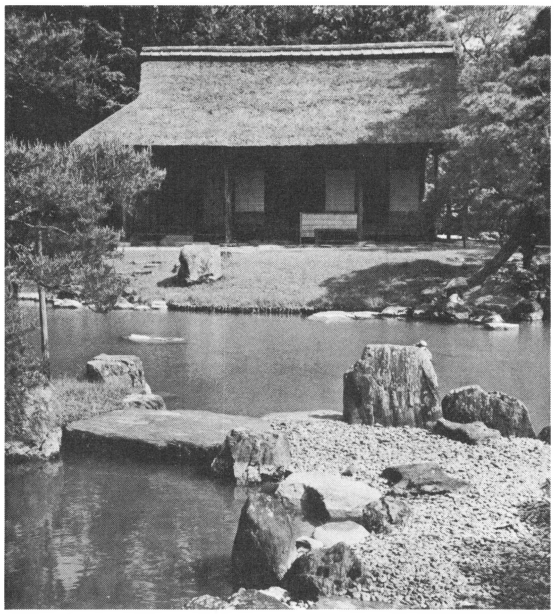
In Africa. In many parts of Africa, the people live in grass shelters, because the trees produce wood that is hard to shape into boards. The Swazi tribe of southeast

WORLD BOOK illustration

Many European Houses retain the charm of medieval times. Their high-pitched roofs and elaborate outside decorations were typical of the homes of the wealthy.

Black Star

Oriental Houseboats provide shelter for many families. Many persons live in boats for a lifetime, cooking their meals, eating them, and sleeping in the same small quarters.



Japan Tourist Assn.

Japanese Houses are famed for their simplicity of design and construction. They feature opaque paper windows and sliding doors. The gabled roofs shed heavy rains.

Africa builds entire villages of dome-shaped grass huts. The tribesmen weave basketlike frames out of young trees and reeds that bend easily. Then they cover the frames with long, slender blades of grass, weaving the grass through the frames. A Swazi hut is so light and strong that its owner can pick it up and carry it wherever he pleases.

In areas with little rainfall, the people often build mud houses. They make a framework of wood and set a grass roof on top. They pat mud into little cakes that look like mud pies, and press them against the sticks of the frame. Then they smooth the mud with wet hands, and let the hot sun bake the mud dry. Mud houses may last 10 years or more. See AFRICA (picture: Shilluk Village in Sudan).

The Egyptians also build shelters of mud bricks, as they have done for thousands of years. They mix mud with straw, mold it into bricks, and lay the bricks in the sun to dry. Egyptian houses have flat roofs and only a few windows. Stairs lead up the outside of the houses to the roofs where the people sleep. Egyptian houses look much like the adobe dwellings of the Indians of the southwestern United States.

History

The First Shelters. Before men knew how to build shelters, they may have lived in trees. Trees kept off some of the rain, and protected men from animals that could not climb. Later, they learned to pile branches and make crude shelters from the wind. Still later, men found caves to live in (see CAVE DWELLERS).

Man slowly learned to make simple tools, first of stone and much later of metal. Tools helped him build better shelters. He built his shelter from the best material he could find to suit his needs. Where there were few trees, man learned to pile stones together to make a shelter. In some places, he found that he could build shelters from the earth itself. He learned how to form clay into small blocks that could be dried in the sun. He built shelters by piling these blocks on each other.

Sometime before 4000 B.C., lake-dwelling peoples learned how to make their homes over water. They drove heavy logs into the lake bottom near the shore and built platforms on the logs. Then they built shelters on the platforms. See LAKE DWELLING.

Homes in Ancient Civilizations. The ancient Egyptians began building their flat-topped homes of sun-dried brick around 3100 B.C. About 2500 B.C., the Assyrians adopted this method of building. The Assyrians discovered that putting bricks into fire made them harder and stronger. They also learned how to burn a glasslike coating on their bricks. We call this *glazing*.

The ancient Greeks lived in well-made stone houses with slanted roofs that carried off snow and rain. The Greeks left the wall facing the street blank, except for a door, so they would not have to look at the narrow, dirty streets. In some places, fresh water was brought into the city through clay pipes. See GREECE, ANCIENT (Family Life).

The Romans copied many of the Greek ideas about building, and added a few of their own, such as central heating. The Romans laid rows of earthenware pipes under the floors and ran hot air or hot water through them to heat the floors. The Egyptians probably first used lead pipes to carry water, but the Romans were the first to use them widely. In fact, the word *plumbing* comes from the Latin word *plumbum*, meaning *lead*. The Romans built their houses around an *atrium*, or central court, with rooms opening off the court. Sometimes they left the court entirely open, but generally they roofed the sides and left only the center open. They made roofs of tile, and often planted lovely gardens around the houses. The Romans had only a few small windows in their walls, but they were the first people to use glass windowpanes. See ROMAN EMPIRE (Family Life).

Shelter in the Middle Ages. The Roman Empire collapsed in the A.D. 400's, and the improvements that the Romans had made in shelter were lost for several hundred years. German and Scandinavian tribes overran Europe. These Northmen constructed a set of buildings called a *ham*, from which the word *home* comes. The principal building of the ham was a long hall called the *heal*. The Northmen supported their buildings with frameworks of heavy wooden timbers, and filled the spaces between the timbers with clay. They covered the high-peaked roof with a layer of bark and a layer of grass sod. They also dug ditches and built earthen walls around their homes, to help protect them from attacks.

Some of these homes developed into the fortified castles of the Middle Ages, with thick stone walls, water-filled moats, and drawbridges. Inside the walls, people built stables for horses, barracks for soldiers, shops for making tools and weapons, kitchens, dining halls, and even a prison for captured enemies. Around 1300, European nobles began building fireplaces in their castles. Townspeople built walls around their towns to protect them from roving bands of warriors or

robbers. Inside the walls, they built their houses several stories high and close together. Many families lived in one building.

About 1400, Europeans began to build half-timbered houses, with brick or stone foundations. They placed a tree trunk at each corner of the house, and set upright wooden beams between the trunks. Then they fastened crossbeams at the tops and bottoms of the upright beams, and added slanting braces. They covered the walls with lath, or thin wooden strips, plastered with a mixture of clay and straw.

By the 1500's, people were building their half-timbered houses three or four stories high. They added bay windows and elaborate fireplaces and stairways.

The Influence of the Renaissance. The Renaissance revived interest in the art and learning of ancient times (see RENAISSANCE). Details of Roman architecture were studied and adapted to form new styles. Kings and nobles hired architects to design elaborate palaces for them. These styles also influenced the houses of the wealthy and middle-class people. Brick became a common building material. Furniture became more plentiful, comfortable, and decorative. Hallways were built so that a person did not have to go through one room to reach another. Water was first piped into London houses about 1619.

In the 1700's, decoration became more dignified. Many wealthy people began to use wallpaper, and sash windows of glass came into common use. Fine furniture designs appeared, such as the Adam, Chippendale, Hepplewhite, and Sheraton, which were named for their makers. The styles of this period are still used.

Indian Shelter. Before the white men came to North America, the Indians built several kinds of shelter from the materials they found in different parts of the continent. The eastern woodland tribes made wigwams by tying wide strips of bark to frames made of young trees bent to form arches. The Iroquois sometimes built bark houses 150 feet (46 meters) long and 20 feet (6 meters) wide.

The Plains Indians had few trees, but they lived among great buffalo herds. These tribes made their tepees by tying a few poles together at the top, spreading them at the bottom like an umbrella, and covering them with buffalo skins.

Indians of the northern Pacific Coast built houses as large as 50 by 60 feet (15 by 18 meters). These houses had frames of heavy beams and posts, and walls and roofs of split cedar planks. The Pueblo Indians of the Southwest often built their homes in the sides of cliffs. They reached their homes by ladders which they drew up in times of danger from wild animals or hostile tribes. Some of their houses were five stories high, with ladders between the floors. For descriptions of the different kinds of shelters that various Indian tribes built, see INDIAN, AMERICAN (Shelter).

Before the Spaniards came to Peru, the Inca made unusual stone shelters. One of these ancient Inca villages still stands at Machu Picchu, Peru. Every house is made of stone blocks cut by hand with stone tools. The Inca built houses on several levels. Stone stairways connected the floors. Stone aqueducts carried water to pools outside the houses where people drank and bathed.

Pioneer and Colonial Shelter. The first European colonists in North America made crude homes by driving pointed logs side by side into the ground and making roofs of thatch or bunches of dried grass. Later, when the pioneers had more time, they built more elaborate log cabins out of timber.

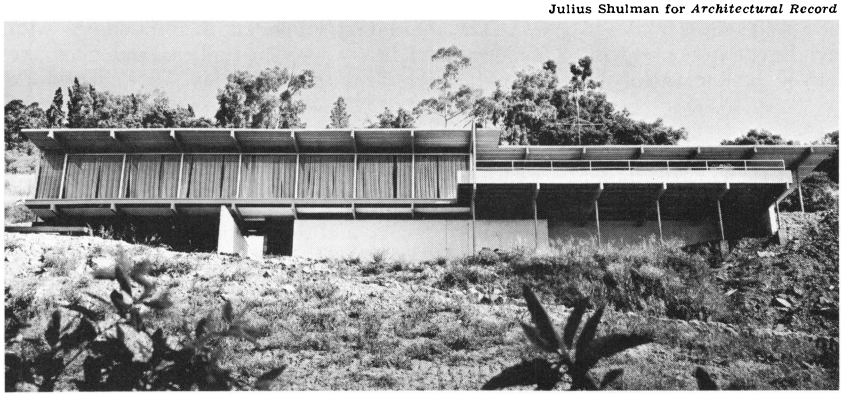
On the vast plains west of the Mississippi River, the pioneers found grassy sod which they used to build shelters. They also dug cellars or caves in the earth, roofed them over with the little lumber they had, and lived in them through the bitter winters.

After they were settled, many of the American colonists built fine homes. Many of these homes resembled houses that the settlers remembered from England and Holland. But the American climate forced the colonists to develop a warmer kind of house. They grouped the rooms around a chimney in the middle of the house for central heating. They made the floors of planks. The New Englanders devised overlapping clapboard walls to keep out the cold winds.

The early Dutch settlers of New York and Pennsylvania brought boatloads of brick from Holland. They made their homes with Dutch roofs, some shaped like stairsteps, and some like the decorations on top of an old-fashioned clock. Such roofs are called "step-roofs" and "clock-roofs." Many of these houses still stand in the northeastern United States.

In the South, wealthy planters built beautiful homes with long porches and two-story columns. Some of these southern homes were made of brick or stone, but most of them were wooden. High ceilings helped keep the rooms cool in summer, and the long porches provided shade for part of the house, usually along the front.

Julius Shulman for *Architectural Record*



A Modern Single-Family Home provides shelter for a Santa Barbara (Calif.) family. The long, low lines of the house, stretched along the side of a hill, blend in nicely with the surrounding terrain.

The Industrial Revolution. During the 1700's, the period called the Industrial Revolution began (see INDUSTRIAL REVOLUTION). Many products, including homes, became cheaper and more abundant. Homes became more comfortable in the 1800's as iron stoves replaced fireplaces. Kerosene lamps often took the place of candles, and gaslight later replaced both. Indoor toilets also became common in the late 1800's.

At the same time, factories needed more and more workers. People who worked in the factories had to live nearby, because they had no automobiles or other means of rapid transportation. Factory owners often built hundreds of small houses close together, and rented them to their employees. Many of these homes were ugly and unsanitary, and slums developed where people lived in poverty and filth. After 1850, tremendous efforts were made to clear up these conditions.

Shelter in the 1900's. Many changes have taken place in shelter during the 1900's. With the development of inexpensive, convenient transportation, people need not live near their jobs. They can live in the suburbs of cities or even in country areas, and still drive to work or take buses and trains.

Today, a house must supply comfort and satisfaction as well as protection. A modern home usually has a washing machine, clothes drier, dishwasher, vacuum cleaner, heating and cooling system, refrigeration, and good lighting. WILLIAM A. BURNS

Related Articles. Many WORLD BOOK articles on countries have a section on shelter. See, for example, CHINA (Shelter). For modern shelter, see HOUSE; HOUSING.

KINDS OF SHELTER

Castle	Igloo	Mobile Home	Tent
Hogan	Lake Dwelling	Quonset Hut	Tepee
Houseboat	Log Cabin	Sod House	Wigwam

OTHER RELATED ARTICLES

Architecture
Cave Dweller
Climate
Colonial Life in America (Houses)
Eskimo (Shelter)
Fallout Shelter
Furniture
Indian, American (Shelter)
Indonesia (Shelter)
Pioneer Life in America (A Pioneer Home)
Western Frontier Life (Frontier Towns; Life in the Country)

Outline

I. Why All Shelters Are Not Alike
- A. Climate
- B. Materials
- C. Dangers

II. Shelter Around the World
- A. In the United States
- B. In Canada
- C. In Latin America
- D. In Europe
- E. In Asia
- F. In Africa

III. History

Questions

How does the amount of rainfall and snow affect the building of roofs?

Who were the first people to use central heating?

Why do some people build shelters on stilts?

What usually determines the choice of materials in building a shelter?

Where are stone "beehive" houses found?

Why do Japanese build houses of light materials?

Why do people in hot, dry climates build houses with thick walls and narrow windows?

What people build shelter to protect them from spirits as well as from natural dangers?

SHELTER BELT is a line of trees or shrubs which are planted to protect the soil of a region from wind and erosion. The Shelter Belt Project, which later became the Prairie States Forestry Project, was created by the United States government in 1934. It was set up under the Forest Service to develop wind barriers on farms in the plains states which had suffered from erosion and dust storms. By the time it was transferred to the Soil Conservation Service in 1942, about 220 million trees had been planted on more than 30,000 farms in the Dakotas, Nebraska, Kansas, Oklahoma, and Texas. The project has since extended its work into other areas of the country. CARL D. DUNCAN

SHEM, a son of Noah. See NOAH.

SHENANDOAH. See AIRSHIP (United States Airships).

SHENANDOAH NATIONAL PARK, *shen uhn DOH uh,* lies in the heart of the Blue Ridge Mountains of Virginia. Established in 1935, the park covers 190,420 acres (77,060 hectares). Most of it is wilderness. Nearly all of the park is at least 2,000 feet (610 meters) above sea level, and it has about 60 wooded mountain peaks. The highest is Hawksbill (4,049 feet, or 1,234 meters). The Skyline Drive runs 105 miles (169 kilometers) through the park along the crest of the mountains. Trails lead from the drive into the mountains.

Azaleas, mountain laurel, dogwood, and other wild flowers grow abundantly there. Wildlife includes red and gray foxes, squirrels, opossums, skunks, minks, weasels, and ground hogs.

Shenandoah National Park is rich in history. George Washington passed through the area during the French and Indian Wars. Battlefields of the Civil War lie on both sides of the mountains. JAMES J. CULLINANE

SHENANDOAH RIVER rises in Augusta County, Virginia, and flows northeast for 170 miles (274 kilometers) through a valley between the Blue Ridge and Allegheny mountains. This largest tributary of the Potomac River joins the main stream at Harpers Ferry, W. Va. For location, see VIRGINIA (physical map). The river is not navigable. The Shenandoah furnishes electric power to the surrounding area. RAUS M. HANSON

SHENANDOAH VALLEY is a beautiful rolling area in northwestern Virginia. It includes the seven counties drained by the Shenandoah River, and much of the area drained by the James River west of the Blue Ridge Mountains. The Massanutten Ridge and other prominent hills rise above the valley. For the location of the Shenandoah Valley, see VIRGINIA (physical map).

Livestock and animal products account for three-fourths of the valley's farm income. The region has many springs, caverns, and other tourist sites. During the Civil War, the Shenandoah Valley saw heavy fighting during General "Stonewall" Jackson's Valley Campaign of 1862 and in cavalry maneuvers involving generals Philip Sheridan and Jubal Early in 1864. Civil War troops used the Valley Pike, now U.S. Route 11. Other highways run from the valley through gaps in the Blue Ridge Mountains.

The valley has several well-known preparatory schools and colleges, including Staunton Military Academy in Staunton and the Virginia Military Institute in Lexington. RAUS M. HANSON

SHENYANG. See MUKDEN.

SHEPARD, ALAN BARTLETT, JR. (1923-), became the first American in space. On May 5, 1961, millions of television viewers watched astronaut Shepard

NASA

Astronaut Alan B. Shepard, Jr., was the first American in space. He also commanded the Apollo 14 moon landing.

rocket 117 miles (188 kilometers) into space from Cape Canaveral, Fla. He landed 15 minutes later, 302 miles (486 kilometers) out in the Atlantic Ocean. In 1971, Shepard commanded Apollo 14, man's third landing on the moon. He became the fifth man on the moon. He had been grounded from 1963 to 1969 because of an ear disorder.

During his first flight, Shepard lay on a padded fiberglass contour couch inside a capsule mounted on a Redstone rocket. The capsule, named *Freedom 7*, weighed more than 2,000 pounds (910 kilograms). Shepard made his historic flight less than a month after Major Yuri Gagarin of Russia had orbited the earth in the world's first manned space trip. Unlike Gagarin's spacecraft, Shepard's ship could be manually controlled during the flight. *Freedom 7* reached a top speed of 5,180 miles (8,336 kilometers) per hour and endured forces 12 times the force of gravity while re-entering the earth's atmosphere.

Shepard was born on Nov. 18, 1923, in East Derry, N.H. He graduated from the United States Naval Academy in 1944. After serving on a destroyer during World War II, he took flight training and became a Navy test pilot. In 1959, Shepard was chosen to be one of the first U.S. astronauts. He received the Distinguished Flying Cross and the Distinguished Service Medal of the National Aeronautics and Space Administration (NASA) for his first historic space flight. In 1971, he became a rear admiral, the first astronaut promoted to this rank. In 1974, Shepard resigned from the astronaut program and the Navy. WILLIAM J. CROMIE

SHEPARD, ERNEST (1879-), is a British painter and illustrator. His illustrations for the *Pooh* stories and poems by A. A. Milne are particularly well known. He also illustrated *Dream Days*, *The Reluctant Dragon*, and other stories by Kenneth Grahame, as well as many books of interest to older readers. His autobiography, *Drawn from Memory* (1957), contains his own illustrations. Shepard was born and educated in London. Early in his career, he worked as a staff cartoonist for the magazine *Punch*. See also LITERATURE FOR CHILDREN (picture: Classics of the 1900's). NORMAN L. RICE

SHEPARD, HELEN MILLER GOULD. See GOULD (Helen Miller).

SHEPHERD COLLEGE is a state-controlled coeducational school of liberal arts and teacher education in Shepherdstown, W. Va. The college features educational tours in Europe and the United States, and holds a political science seminar in Washington, D.C. It grants A.B. and B.S. degrees. It was founded in 1871. For enrollment, see UNIVERSITIES AND COLLEGES (table).

SHEPHERD DOG. See SHEEP DOG.

SHEPHERD LIFE. See ARAB (Nomadic Life); BEDOUINS; IRAN (Agriculture); NOMAD; SHEEP (Raising).

SHEPILOV, *sheh pee LOHV*, **DMITRI TROFIMOVICH** (1905-), was the Russian foreign minister in 1956 and 1957. He became the Communist Party's chief of propaganda in 1949, and editor of *Pravda*, the party's main newspaper, in 1952. Shepilov entered the party's Presidium in 1956, but he was expelled in 1957. He was born in the Krasnodar area near the Sea of Azov.

SHERATON, *SHER uh tun*, **THOMAS** (1751-1806), was the last of the great English furniture designers of the 1700's. He combined a highly developed sense of proportion with an elegance and originality of treatment in his pieces. They were severely simple in form but light and perfectly balanced with decorative details.

Sheraton was born in Stockton-on-Tees, and went to London about 1790 as a journeyman cabinetmaker. Besides being a furniture maker, he was also an author, publisher, bookseller, teacher of drawing, and preacher. See also FURNITURE (Sheraton). OTTO V. HULA

SHERBROOKE, Que. (pop. 80,711), is the trading center of a rich agricultural and industrial region. It lies at the juncture of the Saint Francis and Magog rivers, about 80 miles (130 kilometers) east of Montreal and about 30 miles (48 kilometers) north of the U.S. border (see QUEBEC [political map]). Sherbrooke factories make clothing, silk and artificial silk products, machine tools, rubber goods, jewelry, boats, iron and steel products, building materials, paper products, and plastics.

Gilbert Hyatt, the first settler, built a homestead in 1796. The settlement was known as Hyatt's Mills until 1818, when it was renamed in honor of a former governor general of Canada, Lord Sherbrooke. The city was incorporated in 1875. A large number of people of both French and English descent live there, and it has become the custom to elect alternately French- and English-speaking mayors. Sherbrooke has a mayor-council form of government. M. G. BALLANTYNE

SHERBROOKE, UNIVERSITY OF, is a coeducational Roman Catholic school in Sherbrooke, Quebec. It offers bachelor's, master's, and doctor's degrees, and has a medical school. It was started in 1875 as the Seminary of Sherbrooke, and became a degree-granting university in 1954. For enrollment, see CANADA (table: Universities). ROGER MALTAIS

SHERIDAN, Wyo. (pop. 10,856), is the largest city in the northern part of the state. It lies in the fertile Goose

Creek Valley, about 15 miles (24 kilometers) east of the Bighorn Mountains (see WYOMING [political map]). Sheridan is the seat of Sheridan County.

Vacationists enjoy nearby dude ranches. The Eaton brothers, Howard, Alden, and Willis, established the West's first dude ranch near Sheridan in 1904. Coal, livestock, and agriculture contribute to Sheridan's economy. The city was founded in 1882. T. A. LARSON

SHERIDAN, PHILIP HENRY (1831-1888), was a Union general during the Civil War. A captain at the outbreak of the war, "Little Phil," as he became known, rose rapidly in rank. He commanded a division at the battles of Perryville and Stones River, and became a major general of volunteers. In 1863, he became a corps commander in the Army of the Cumberland. He fought at Chickamauga, and in the Battle of Chattanooga his corps broke the Confederate line on Missionary Ridge. Grant named Sheridan to lead the cavalry of the Army of the Potomac in 1864.

Brown Bros.

Philip H. Sheridan

Sheridan guarded the flanks of the Union Army in Virginia, and attacked General Robert E. Lee's communications. When Confederate forces appeared in the Shenandoah Valley, General Ulysses S. Grant gave Sheridan command of all Union forces in that area. Sheridan was instructed to drive the enemy from the valley and to destroy the region's economic resources. He defeated the Confederate troops, under General Jubal A. Early, at Winchester, Fisher's Hill, and Cedar Creek.

Sheridan was at Winchester when fighting broke out at Cedar Creek. He rode 11 miles (18 kilometers) to take command of his men, who had been driven back 4 miles (6 kilometers) from Cedar Creek. Thomas B. Read's stirring poem, "Sheridan's Ride" (1865), wrongly indicates that Sheridan rode 20 miles (32 kilometers). Returning to Grant's command, Sheridan broke Lee's right flank at Five Forks, and helped force the evacuation of Petersburg and Richmond. In 1864, he became a major general in the Regular Army.

There is a mystery surrounding Sheridan's birthplace. His parents came from County Cavan, Ireland, and he was reared at Somerset, Ohio. He was graduated from the United States Military Academy.

After the Civil War, Sheridan was commander of the Division of the Gulf, where he worked to force the French out of Mexico. During Reconstruction, he commanded the Fifth Military District (Louisiana and Texas). Later, he headed the Department of the Missouri, and conducted operations against hostile Indians. He became a lieutenant general in 1869, and the following year he went to Europe to observe the Franco-Prussian War. He succeeded General William T. Sherman in 1884 as army commander, and in 1888 he became a full general.

In the closing months of his life, Sheridan wrote his recollections, *Personal Memoirs*. He was buried in the National Cemetery at Arlington, Va. T. HARRY WILLIAMS

See also CIVIL WAR (picture: Sheridan's Ride).

SHERIDAN, RICHARD BRINSLEY (1751-1816), was an Irish dramatist and politician. During his brief writing career, he produced several sparkling comedies. In later life, he was a brilliant speaker in the British Parliament.

While in his early 20's, Sheridan wrote *The Rivals* (1775). This comedy has a memorable character named Mrs. Malaprop who is a genius at using words incorrectly, as when she says, "Illiterate him, I say, quite from your memory." *The School for Scandal* (1777), Sheridan's finest play, is one of the great comedies of English drama. With glittering wit, the play exposes society people who love malicious gossip. It also contrasts a careless but kind young man, Charles Surface, with his scheming and selfish brother Joseph. *The Critic* (1779), a short satiric play, attacked theatrical fashions in a witty manner. Sheridan's other plays include the farce *St. Patrick's Day* (1775) and a comic opera *The Duenna* (1775). He also adapted Sir John Vanbrugh's comedy *The Relapse* into *A Trip to Scarborough* (1777).

Sheridan was born in Dublin, the son of an actor-manager, and grew up in England. Sheridan eloped with a beautiful singer in 1772, and fought two duels because of her. In 1776, he became manager of the Drury Lane theater, and it was his chief source of income for many years.

In 1780, Sheridan was elected to Parliament. From that date until 1812, he devoted himself to politics. A gifted orator, Sheridan made a memorable speech in the trial of Warren Hastings (see HASTINGS, WARREN). A man of great charm and wit, Sheridan lived a busy social life among the rich and the powerful. He is best remembered for his witty plays, but he spent little of his life as a writer. THOMAS H. FUJIMURA

SHERIFF, in the United States, is one of the chief administrative officers of a county. It is his duty to take charge of prisoners, to oversee juries, and to prevent breaches of the peace. He also carries out the judgments of the county court. For example, if the court gives a judgment against a debtor, the sheriff seizes his property and sells it to satisfy the claims of creditors. The sheriff may perform these duties himself, or he may give other persons the power to act in his name. These persons are called *deputy sheriffs*. In most states, the voters elect the sheriff. In Canada, sheriffs are appointed.

The word *sheriff* comes from old England. Each *shire*, or county, had a headman known as a *reeve*. The title *shire reeve* gradually came to be run together in the single word *sheriff*. H. F. ALDERFER

See also COUNTY; LAW ENFORCEMENT; SHIRE.

SHERMAN is the family name of two American brothers, a military leader and a statesman.

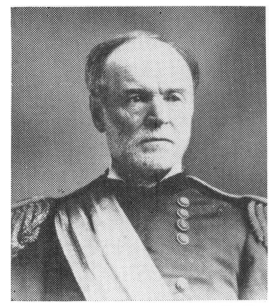
William Tecumseh Sherman (1820-1891) was a Union general in the Civil War and the commanding general of the United States Army for 14 years. His greatest feat in the war was to march an army across Georgia, "from Atlanta to the sea," and then through South Carolina. On the way, he destroyed the South's last economic resources. Because he waged economic warfare against a civilian society, Sherman has been called the first modern general. He is supposed to have said, "War is hell."

Sherman commanded a brigade at the first battle of Bull Run. He was promoted to brigadier general of

volunteers, and took command of the Department of Kentucky. His anxiety over the safety of his position caused him to be relieved. Early in 1862, he came under Ulysses S. Grant's command, and fought with Grant at Shiloh. As major general and corps commander, he took part in the capture of Vicksburg in 1863. Later he helped relieve the Union army at Chattanooga.

In 1864 Grant appointed Sherman commander of Union forces in the West. With three armies totaling about 100,000 men, Sherman captured Atlanta, and then started his famous march to the sea. After Savannah fell, he moved north through the Carolinas. In April, General Joseph E. Johnston surrendered to him.

Sherman was born in Lancaster, Ohio. His father died when Sherman was young, and Thomas Ewing, an Ohio political figure, adopted him. Sherman was graduated from the United States Military Academy. He served at various posts in the South, and fought in the Mexican War. In 1853 he resigned from the army.



Brown Bros.

William Tecumseh Sherman

Everything Sherman tried as a civilian seemed to end in failure. He became a banker in San Francisco, and the bank collapsed in the panic of 1857. He practiced law in Kansas, and lost the only case he ever tried. He became superintendent of a military academy in Louisiana (later Louisiana State University), but resigned when the state seceded. Then he became president of a St. Louis street railway company.

Sherman was a major general in the regular army at the end of the war. He succeeded Grant in 1869 as commanding general of the army with the rank of full general. Many people tried to induce him to run for President, but he refused. He said, "I will not accept if nominated and will not serve if elected." He wrote *Memoirs of General W. T. Sherman.* T. Harry Williams

John Sherman (1823-1900) was an American statesman. He became noted for introducing the silver and antitrust laws that bear his name (see Trust [Trust Legislation]). For almost 50 years Sherman held office in Washington, D.C., either as a Republican member of Congress or in the Cabinet. He was elected to the House of Representatives from Ohio in 1854, and seven years later was elected to the Senate. Sherman served as secretary of the treasury from 1877 to 1881, and then returned to the Senate. His last public office was as secretary of state in 1897 and 1898. He was born in Lancaster, Ohio. Arthur A. Ekirch, Jr.

SHERMAN, FORREST PERCIVAL (1896-1951), was the youngest man up to that time to hold the United States Navy's top post, chief of naval operations. He assumed this post in 1949, when the navy was deeply disturbed by technological changes and conflicts within the Department of Defense. By his ability and knowledge, he guided the service through a difficult period.

Sherman was born in Merrimack, N.H. During World War II, he commanded the aircraft carrier *Wasp*, until it was sunk in the Solomon Islands. Later, as deputy chief of staff to Fleet Admiral Chester W. Nimitz, he prepared plans for most of the navy's Central Pacific campaigns. He took part in the Japanese surrender talks, and became a vice-admiral in 1945. Donald W. Mitchell

SHERMAN, JAMES SCHOOLCRAFT (1855-1912), served as Vice-President of the United States from 1909 to 1912 under President William Howard Taft. He became the first Vice-President to be renominated in the history of the Republican Party, but he died during the election campaign. His death created a unique situation in American politics. It was too late to replace him on the ballot, and over 3 million people voted for Taft and Sherman. Sherman's eight electoral votes were cast for Columbia University president Nicholas Murray Butler.

Sherman was born in Utica, N.Y. He started practicing law in 1880, and served as mayor of Utica in 1884. He served in the U.S. House of Representatives from 1887 to 1891 and from 1893 to 1909. Irving G. Williams

See also Vice-President of the U.S. (picture).

SHERMAN, ROGER (1721-1793), was the only man who signed all four of these great documents: the Articles of Association (1774), the Declaration of Independence (1776), the Articles of Confederation (1777), and the United States Constitution (1787). Sherman was born in Newton, Mass., but in 1743 he moved to Connecticut where he became prominent in business and politics. He served as judge of the Connecticut Superior Court from 1766 to 1789.

U&U

Roger Sherman

Sherman feared excesses when the revolutionary movement began, but he was among the first to deny the supremacy of the British Parliament over the colonies. He was influential in the Continental Congress, where John Adams said he was "as firm in the cause of American Independence as Mount Atlas." During the Constitutional Convention of 1787, he presented the Connecticut Compromise that resolved the differences between the large and small states on representation in the national legislature (see Constitution of the United States [The Compromises]). He served his state in the U.S. Congress as representative from 1789 to 1791, and as a senator from 1791 to 1793. Clarence L. Ver Steeg

SHERMAN ANTITRUST ACT. See Harrison, Benjamin (Domestic Affairs); Trust (Trust Legislation).

SHERMAN SILVER PURCHASE ACT. See Cleveland, Grover (Saving the Gold Standard); Harrison, Benjamin (Domestic Affairs).

SHERPA. See Nepal (The People).

SHERRINGTON, SIR CHARLES SCOTT. See Nobel Prizes (table: Nobel Prizes for Physiology or Medicine —1932).

SHERWOOD, ROBERT EMMET (1896-1955), was an American playwright, journalist, and biographer who stressed the evils of war in his writings. His play *Idiot's Delight* (1936) lamented the approaching outbreak of war in Europe. *Abe Lincoln in Illinois* (1938) used Lin-

coln's own words to show the necessity of firm action in the face of war. *There Shall Be No Night* (1940) opposed Russia's invasion of Finland. It was also Sherwood's stand against what he called mankind's hysterical desire to escape from reality. All three of these plays won Pulitzer prizes.

Sherwood was born in New Rochelle, N.Y. In 1920, he joined *Life* magazine. He became a nationally-known film critic at *Life*, and was the magazine's associate editor from 1924 to 1928.

Sherwood's first produced play, *The Road To Rome* (1927), was a satire on Hannibal's campaign against Rome. It said every sacrifice in the name of war is wasted. *The Petrified Forest* (1935) showed criminal morality triumphing in the world. During World War II, Sherwood wrote speeches for President Roosevelt. He won a Pulitzer prize for his biography *Roosevelt and Hopkins: An Intimate History* (1948). THOMAS A. ERHARD

SHERWOOD FOREST. See ROBIN HOOD.

SHETLAND ISLANDS lie in the Atlantic Ocean near the North Sea. The islands are Great Britain's most northerly European possession. They lie about 50 miles (80 kilometers) northeast of Scotland's Orkney Islands, and 210 miles (338 kilometers) west of Norway (see EUROPE [color map]).

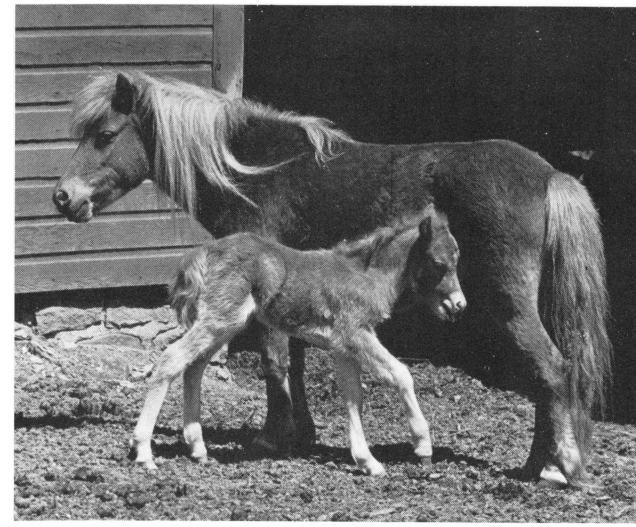
Over 100 islands make up the group, but people live on fewer than 20 of them. Some islands have only lighthouse keepers and a few shepherds. The islands have an area of 552 square miles (1,430 square kilometers), and a population of about 18,000. These people are of Scandinavian origin and their language still contains Icelandic words. Many Norse customs still survive. Ancient stone towers stand on the islands. The county seat, Lerwick, is on Mainland, the largest island.

The Shetland Islands have a wild, colorful beauty. Their rugged coasts rise from the ocean in deeply cut cliffs. Lonely lighthouses stand on hills that overlook the sea. Many tourists visit the islands in summer, when daylight remains almost around the clock. In winter, there is little daylight. The famous small, shaggy Shetland ponies, the long-wooled Shetland sheep, and an unusually small breed of cattle inhabit the islands. The Shetland Islands contain peat, copper, and iron deposits.

The main occupations of the Shetland people are weaving, knitting, fishing, and raising cattle, sheep, and ponies. Farmers raise oats, barley, and vegetables. Knitting hosiery and shawls is an important home industry. There once was considerable whale hunting off the Shetland Islands. FREDERICK G. MARCHAM

SHETLAND PONY is one of the smallest of all horses. It stands from 32 to 46 inches (81 to 117 centimeters) high. The original Shetlands came from the Shetland Islands of Great Britain. They were short and stocky. People used Shetlands to pull coal carts in the mines, because they were strong and required little food. Shetlands were imported to the United States as children's pets. But horse breeders decided that a lighter, flashier type of pony would be more popular. To gain these characteristics, they bred the Shetland with the Hackney pony. Today, many Shetlands have so much Hackney blood that they are no longer suitable for children. But their slender legs; fine, delicate heads; and silken manes and tails make them popular show animals.

Some Shetlands still make excellent pets for children. However, they are intelligent and crafty animals, and must be trained by an expert. MARGARET CABELL SELF



Walter Chandoha

The Shetland Pony is one of the smallest breeds of horses. Long, thick hair protects these animals from cold and dampness.

SHETLAND SHEEP DOG is considered one of the most beautiful of all herding dogs. It is short, standing only from 13 to 16 inches (33 to 41 centimeters) high. It was bred to herd the small livestock of the Shetland Islands. The Shetland looks dainty and fragile, but it is a rugged dog, capable of hard work. Sheep raisers in the western United States use the Shetland because it can cover large areas without getting sore feet. The Shetland looks somewhat like a miniature collie. It is more gentle than some heavier types of herding breeds. It makes a good pet and an excellent watchdog. See also DOG (color picture: Working Dogs). OLGA DAKAN

SHEVCHENKO, *shehf CHAYN koh*, **TARAS** (1814-1861), was a leading Ukrainian patriot and the Ukraine's most famous poet. Shevchenko and other Ukrainians organized the Society of Saints Cyril and Methodius in 1843. The society led an unsuccessful movement to win the Ukraine's independence from Russia. To punish Shevchenko, the Russian government sent him to serve at an army post in the Ural Mountains in 1847. Shevchenko's poems include *Katerina* (1840), *Haydamaki* (1841), and *The Dream* (1844). His poems describe the hard life of the Ukrainian people and express their desire for freedom. He was born in Kiev. GEORGE KISH

SHEVOUT. See SHABUOT.

SHEYENNE RIVER. See NORTH DAKOTA (Rivers).

SHIAH or SHIITE. See ISLAM (Sects); IRAN (People).

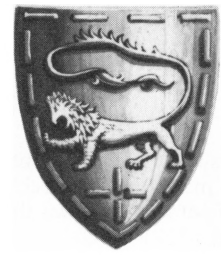
SHIELD, *sheeld*, was the chief means of protection in war from earliest times until the invention of firearms. Shields of wood, sometimes covered with animal hide, could be held in one hand to ward off blows of an enemy, while the other hand was free to use a club, sword, or spear. Later, metal shields were used.

Shields were of many sizes and shapes. The Greeks used both round and oval shields which were heavy and almost covered the body. A large shield called the *clipeus*, at first circular, was used by the Greeks and the Romans. The Romans introduced the rectangular shield.

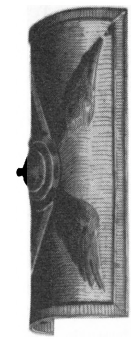
Canvas-covered shield of medieval Germany

Shield of the Black Prince, son of Edward III of England

Grotesque shield of Charles I of Spain



Typical Crusader's shield



Roman shield

Shields Used by Soldiers of ancient and medieval times varied in size, shape, and design. Many kings, knights, and noblemen were identified by their shields.

They also used a large, oblong shield called a *scutum*.

During the Middle Ages, both armored knights and common foot soldiers used the shield. The knights' shields were decorated with their coats of arms, so they could be recognized even when in full armor. If the shield was to be held at arm's length, it was called a *buckler*. If fastened to the arm, and held across the body in combat, the shield was called a *target*.

Many tribes still carry shields to war or when hunting wild animals. These shields are usually made of wood covered with hide. *Shield*, in modern warfare, is the armor-plate covering installed around a gun to protect the gun's crew from enemy fire. THEODORE ROPP

See also ARMOR; INDIAN, AMERICAN (pictures).

SHIELDS, JAMES (1806-1879), served as governor of the Oregon Territory and as a brigadier general of volunteers in the Mexican and Civil wars. A Democrat, he also served as a U.S. Senator from Illinois, Minnesota, and Missouri. Shields was born in County Tyrone, Ireland, and came to the United States in 1826. Illinois placed a statue of Shields in the Statuary Hall collection in the U.S. Capitol in 1893. T. HARRY WILLIAMS

SHIFTING CULTIVATION. See AGRICULTURE (Kinds).

SHIH HUANG TI, *shir hwahng tee* (259?-210 B.C.), was an emperor of China. He created the first united Chinese empire, founded the Ch'in *dynasty* (a series of rulers of the same family), and completed much of the Great Wall of China.

Shih Huang Ti became ruler of the Chinese state of Ch'in in 247 B.C. Between 234 and 222 B.C., he conquered other states and replaced local rule with a strong central government. In 221 B.C., he proclaimed himself the first emperor of China. To keep out invaders from the north, he linked short walls built by earlier rulers and created the Great Wall of China.

Shih Huang Ti ruled harshly. He executed many persons who opposed him and used forced labor to build the Great Wall. He also burned many writings that might have influenced people against him. The Ch'in dynasty fell from power in 206 B.C. EUGENE BOARDMAN

See also GREAT WALL OF CHINA; CH'IN DYNASTY.

SHIH TZU, *sheed zoo*, is a breed of toy dog related to the Pekingese and Lhasa apso. It comes from China and Tibet. The Shih Tzu has a broad head and large, dark eyes. Its drooping ears are fringed with long hair, and its snout is short and square. The dog's long, thick coat may be any color. The dog grows 9 to $10\frac{1}{2}$ inches (23 to 27 centimeters) high and weighs 12 to 15 pounds (5 to 7 kilograms). JOSEPHINE Z. RINE

Walter Chandoha

The Shih Tzu Comes from China and Tibet.

SHIITE. See ISLAM (Sects).

SHIKOKU. See JAPAN (Land Regions).

SHILLING was a coin in the British money system. It was equal to 12 pence, and was $\frac{1}{20}$ of a pound sterling. The shilling was replaced in 1971 by a coin of equal value, the five new pence piece.

See also PINE-TREE SHILLING.

SHILOH, BATTLE OF. See CIVIL WAR (The War in the West; table: Major Battles).

SHILOH NATIONAL MILITARY PARK. See NATIONAL PARK SYSTEM (table); TENNESSEE (picture).

SHIMMY. See DANCING (The 1900's).

SHIMONOSEKI, TREATY OF. See CHINESE-JAPANESE WARS.

SHINGLES is a painful disease in which small clusters of blisters form on the skin of the face, neck, chest, stomach, or limbs. These blisters usually follow the path taken by a *sensory* (feeling) nerve. Doctors call shingles *herpes zoster*. It is believed that shingles results from a virus infection of the nervous system.

Shingles often starts with intense pain in the area where the blisters form later. The blisters are usually pink or white. At first, they contain a colorless liquid, but pus may form later. After about a week, the blisters dry up and disappear. The diseased area may feel irritated after the blisters dry up.

Children usually recover quickly from shingles. But adults recover slowly and the pain lasts longer. Doctors treat shingles with pain-relieving drugs, and when pain is intense, may inject nerve areas with an *anesthetic* (pain-blocker). Other treatments include ultraviolet rays, X rays, and antibiotics. LOUIS D. BOSHES

See also HERPES.

SHINGLES are thin pieces of wood, asbestos, slate, or other materials that are used to cover the roofs and outer walls of buildings. Wooden roof shingles are usually 16 inches (41 centimeters) long. They are cut thicker at one end, and taper from about $\frac{1}{2}$ inch (13 millimeters) to less than $\frac{1}{8}$ inch (3 millimeters).

Shingles laid on a roof should overlap so that there are at least three layers at all points. On walls, however, only two layers need be nailed over each other.

Flat-grain shingles are made by sawing wood parallel to the annual growth rings. *Edge-grain* shingles are sawed more or less at right angles to the rings. A roof laid with good edge-grain shingles will last many years longer than a roof laid with flat-grain shingles. Most shingles produced in North America are made of western red cedar. ARTHUR KOEHLER

SHINN, EVERETT (1876-1953), was an American painter and illustrator. Most of his works portray theater life, with its changing moods and lively movement. Shinn also designed sets for the theater and for films.

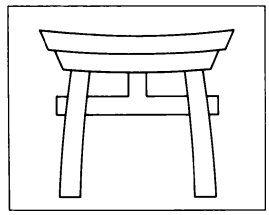
Shinn was born in Woodstown, N.J. He began his career in 1893 as a newspaper illustrator and cartoonist. He illustrated for magazines in his later years. The influence of his work as an illustrator can be seen in the brilliant draftsmanship in his paintings. In 1908, Shinn joined a group of realistic painters organized by Robert Henri, called *The Eight* (later the *Ashcan School*). Within this group, Shinn showed the lightest and most delicate touch in his paintings. For more information on *The Eight*, see HENRI, ROBERT. E. MAURICE BLOCH

SHINNY, or SHINTY. See FIELD HOCKEY (History); INDIAN, AMERICAN (picture: Games of All Kinds).

Chase Manhattan Bank Money Museum

Face and Reverse Side of a Shilling of 1723

SHINTO, *SHIHN toh*, is the oldest surviving religion of Japan. The word *Shinto* means *the way of the gods*. Shintoists worship many gods, which are called *kami*. According to Shinto, kami are the basic force in mountains, rivers, rocks, trees, and other parts of nature. Shinto also considers kami the basic force in such processes as creativity, disease, growth, and healing.



A Wooden Gate called a *torii* is the symbol of Shinto. A torii stands at the entrance of a Shinto temple. It consists of two posts connected by crossbars. The posts represent pillars that support the sky, and the crossbars symbolize the earth.

Shinto emphasizes rituals and moral standards. It does not have an elaborate philosophy, and, unlike many religions, it does not stress life after death.

About 63 million persons practice Shinto. Many Shintoists worship at small shrines in their homes. Roadside shrines dedicated to certain kami are also common. Some public shrines consists of several buildings and gardens. Individual worshipers recite prayers and offer gifts of cakes and flowers to the kami.

On certain occasions, Shinto priests lead ceremonies called *matsuri*. One of the most important Shinto rituals is the Great Purification Ceremony. It consists of a confession of sins committed by individuals and by the nation as a whole, followed by a request that the kami remove the impure conditions caused by these sins. Other ceremonies deal with such basic goals as long life, peace, abundant harvests, and good health.

No one knows when or how Shinto began. But Shintoists have always worshiped the kami through nature. Shinto myths appear in the *Nihongi* (*Chronicles of Japan*) and the *Kojiki* (*Record of Ancient Things*), both written in the A.D. 700's. These myths tell how the kami created the world and established customs and laws. According to Shinto mythology, the sun goddess became the ancestor of Japan's imperial family.

Beginning about the A.D. 500's, the Chinese philosophies of Buddhism and Confucianism influenced Shinto. Shintoists identified Buddhist gods as kami, and shrines adopted Buddhist images to represent the kami. Buddhist ceremonies were used for funerals and memorial services. Under the influence of Confucianism, Shinto developed such moral standards as honesty, kindness, and respect for one's elders and superiors.

During the 1800's, many Shintoists began to reject the Buddhist influence. In the mid-1800's, a movement called *State Shinto* stressed patriotism and the divine origins of the Japanese emperor. After Japan's defeat in World War II in 1945, the emperor denied that he was divine, and the government abolished State Shinto.

Later movements of Shinto, called *New Religions*, attracted many followers in Japan during the 1800's and 1900's. The New Religions center around the teachings of a particular person or group. Some of them encourage group worship, charity work, and the organization of society on a cooperative basis. ALAN L. MILLER

See also JAPAN (Religion).

Farrell Grehan, Photo Researchers

Sturdy Cargo Ships like these freighters in the harbor at Rotterdam, The Netherlands, are the workhorses of the sea. They carry much of the trade among the countries of the world.

SHIP

SHIP is one of man's oldest and most important means of transportation. Every day, thousands of ships cross the oceans, sail along seacoasts, and travel on inland waterways. Trade among countries depends heavily on ships. For example, ships carry wheat from Canada to West Germany and chemical products from West Germany to Thailand. They haul Thai rubber to the United States and American machinery to Libya. Ships transport Libyan wool to Russia, Russian coal to France, and French plastics to Canada.

Many kinds of ships are used to carry the world's trade. Giant tankers haul petroleum, soybean oil, wines, and other liquids. Refrigerator ships carry fresh fruits, meats, and vegetables. Vessels called *dry bulk carriers* haul such cargoes as grain, ore, and sand. General cargo ships transport everything from airplane engines to yo-yos. Passenger liners carry travelers across the oceans and vacationists on cruises to the Mediterranean and Caribbean seas and other warm areas.

For many hundreds of years, men have gone down to the sea in ships. They have been drawn by the mysteries of the sea and by its promise of adventure. More important, men have sailed the seas to explore, to settle, to trade, and to conquer. In 1492, Christopher Columbus braved the unknown waters of the Atlantic Ocean in three small sailing ships and discovered the New World. During the 1500's, Spanish ships carried *conquistadors* (conquerors) to Latin America. The conquistadors soon won control of much of the region for Spain. During the 1600's, big sailing ships called *East Indiamen* carried silks, spices, and other riches from the Far East to Europe. An old trading ship called the *Mayflower* brought the first Pilgrim settlers to America in 1620. During the mid-1800's, steam-powered ships began to replace sailing vessels. The world quickly became much smaller as steamships crossed the seas in a fraction of the time that sailing ships needed. Thus, ships have brought countries and peoples closer together and made them strongly dependent economically on one another.

Throughout history, nations have become rich and powerful by controlling the seas in war and peace. When countries have lost that control, they have declined. Today, ships are as important as ever to a country's prosperity and strength. The United States, the world's leading trading nation, depends largely on ships for its imports and exports. The economies of Great Britain, Japan, West Germany, and many other countries would soon be badly crippled if there were no ships to bring in food and raw materials and to carry out manufactured goods. All the great trading nations try to have a large *merchant marine*. A merchant marine consists of the commercial, or merchant, ships of a country.

The difference between a ship and a boat is chiefly a matter of size. Large oceangoing vessels are called *ships*. All other craft are called *boats*.

This article deals mainly with merchant vessels. For information on naval vessels, see the WORLD BOOK articles on NAVY and WARSHIP. For information on pleasure boats, see BOATING.

Lionel Casson, the contributor of this article, is Professor of Classics at New York University and the author of The Ancient Mariners, Illustrated History of Ships & Boats, *and* Ships and Seamanship in the Ancient World. *The historical drawings were critically reviewed by Robert H. Burgess, Curator of the Mariners Museum, Newport News, Va.*

John Launois, Black Star

Luxurious Cruise Ships sail to the Caribbean and Mediterranean seas and other warm areas. They offer vacationists fine food, excellent accommodations, and fun-filled days and nights.

SHIP / *History*

Man's first "ship" was probably a log that he used to cross a lake or river. He probably used his hands as paddles. Later, men learned to build rafts by lashing logs together. In time, they discovered how to make dugouts and bark canoes. In regions where wood was scarce, early men made boats of other materials. For example, they sewed animal skins into a bag, which they then blew up and used as a float. Several floats tied together could support a raft. In some areas, the people found that little clay pots tied together could hold up a raft. They also learned that a large pot made a one-man boat.

In ancient Egypt and certain other regions, the people made their first rafts of bundles of reeds. In time, the Egyptians learned to lash bundles of reeds together to make boats with a spoonlike shape. By about 4000 B.C., they had learned to build *galleys*—long, narrow boats powered by a row of paddlers. During the next 1,000 years, the Egyptians made two more great advances in the development of ships. By about 3200 B.C., they had invented sails and so could use the power of the wind to propel their boats. About 3000 B.C., they learned to build boats out of planks of wood. After men knew how to make plank boats, they could build them any size. They could even build ships—vessels big enough to cross the oceans.

The Age of Sailing Ships

The basic pattern for ships became set with the invention of the sail and then of the vessel built of planks. For about the next 5,000 years, shipbuilders concentrated on designing bigger and bigger ships and on improving the *rig*—the sails with their masts and ropes. Shipbuilders of ancient times succeeded in building ever-larger ships, but they made little progress with the rig. Big improvements in the rig began during the 1400's and reached a high point with the development of the great sailing ships of the 1800's.

IMPORTANT DATES IN SHIP DEVELOPMENT

c. 3200 B.C. The Egyptians invented sails.

c. 3000 B.C. The Egyptians learned to build boats out of planks of wood.

c. 500 B.C. The Greeks built the first vessels with two masts.

c. 1300 A.D. Shipbuilders in northern Europe introduced the stern rudder.

c. 1450 Mediterranean shipbuilders developed the full-rigged sailing ship.

1807 The *Clermont*, built by Robert Fulton of the United States, became the first commercially successful steamboat.

1818 Great Britain launched the *Vulcan*, the first known all-iron sailing ship.

1819 The American ship *Savannah* became the first steam-powered vessel to cross the Atlantic Ocean, though it used its engines only about 85 hours during the 29-day voyage. The *Savannah* used sails the rest of the trip.

1836 Francis Pettit Smith, an Englishman, and John Ericsson, a Swede, patented propellers to drive steamboats.

1838 Great Britain's *Sirius* became the first ship to cross the Atlantic Ocean under steam power alone.

1897 Charles A. Parsons of England demonstrated the efficiency of steam turbines in his launch, the *Turbinia*.

1910-1911 The first motorships went into operation.

1959 The United States launched the *Savannah*, the first nuclear-powered merchant ship.

1969 The American tanker *Manhattan* became the first commercial ship to sail through the Northwest Passage.

Egyptian Ships. The ancient Egyptians designed many kinds of vessels, including small graceful canoes, beautiful yachts, and heavy freighters. Their most outstanding achievement was probably the huge barges that carried enormous stone pillars called *obelisks* from quarries up the Nile River. The biggest barges measured more than 200 feet (61 meters) long and carried 750 short tons (680 metric tons) of cargo.

One sail and a line of oarsmen on each side propelled the yachts and other light Egyptian vessels. The heavier craft were driven by only a sail. The Egyptians used a rectangular sail, which is called a *square sail*. At first, they made the sail tall and narrow. But after 2000 B.C., they made it much wider than tall. They steered their ships with large oars on each side near the stern.

The Egyptians built their vessels chiefly for use on the Nile. As a result, they made all their craft—even ships used on the sea—rather light. Today, boats of planks are built by first making a skeleton of *keel* (backbone) and ribs and then fastening the planks of the hull to the ribs. But the Egyptians built their river craft without a keel or ribs. They simply fitted the planks together by means of joints to form the hull. These vessels were sturdy enough to sail on the Nile, but they were too weak for the rougher Mediterranean Sea.

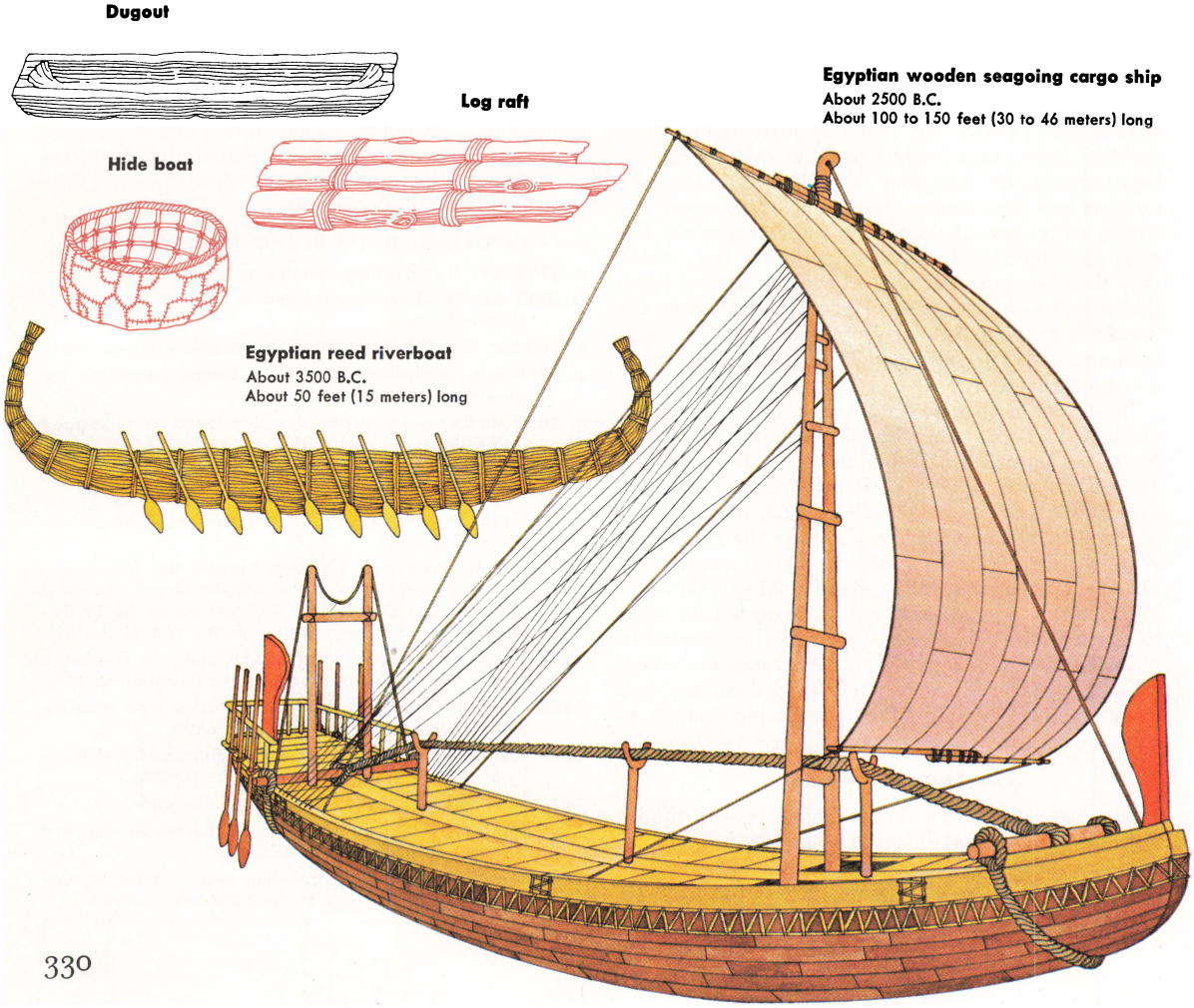
The seagoing ships of the Egyptians probably had some kind of keel and a few ribs. But the bow and stern tended to droop, especially in rough seas. So the Egyptians wound a heavy rope around the bow, stretched it tightly across the deck, and looped it around the stern. The rope strengthened the vessels and kept the bow and stern from sagging. The Egyptians sailed chiefly on the Red Sea and along the eastern shore of the Mediterranean.

Minoan and Mycenaean Ships. The Minoans, who lived on the island of Crete, became the first true seafaring people of the Mediterranean region. As early as 2500 B.C., their ships ranged the eastern Mediterranean and as far west as the island of Sicily. About 1500 B.C., the Mycenaeans, who lived on what is now the Greek mainland, won control of the sea. The Minoans and

PREHISTORIC AND ANCIENT EGYPTIAN SHIPS

Man's first "ships" included dugouts, log rafts, and boats made of hides stretched over a frame. The ancient Egyptians made some of the greatest advances in the development of ships. By about 4000 B.C., they learned to build long, narrow reed boats powered by a line of paddlers. By about 3200 B.C., they discovered sails. Around 200 years later, the Egyptians learned to construct boats of planks of wood. Man could then build ships—vessels large enough to cross the open seas.

WORLD BOOK illustrations for the *History* section by George Suyeoka



Mycenaeans both helped develop the seagoing sailing ship. But historians know little about their ships. All they know for sure is that these peoples built cargo vessels that were sturdy and roomy and had one square sail. The Minoans and Mycenaeans also built strong war galleys propelled by a row of oarsmen on each side.

Phoenician and Greek Ships. Scholars know much more about the ships used on the Mediterranean Sea after about 1200 B.C. At that time, the leading seafaring peoples were the Phoenicians, who lived along the eastern shore of the Mediterranean, and the Greeks.

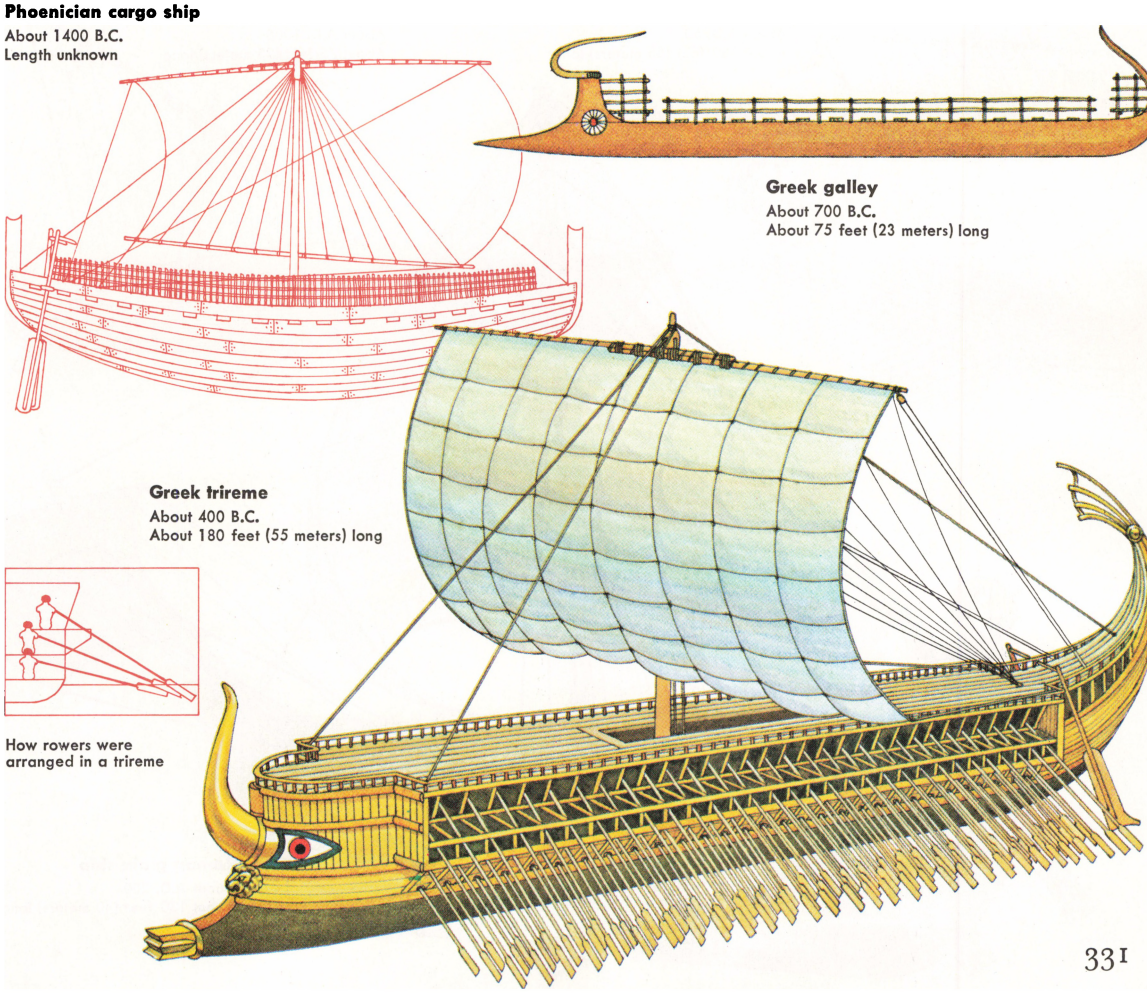
The Greeks and Phoenicians built broad, roomy cargo ships and greatly improved the ship rig. About 500 B.C., they built the first vessels with two masts. The second mast sloped forward over the bow. It supported a small square sail that made steering easier. After 300 B.C., the Greeks set a triangular sail above the mainsail. On their biggest ships, they added another square sail near the stern. This simple four-sail rig was the most advanced rig ever developed by the peoples of ancient times. As a result, ancient ships were slow and could travel at an average speed of only about 5 knots with the wind. The standard Greek freighter measured about 100 feet (30 meters) long and could carry 100 to 200 short tons (91 to 180 metric tons) of cargo.

The Greeks used galleys for warships. Their earliest galleys had a line of rowers on each side. Between 1000 and 800 B.C., the Greeks added a large sharp *ram* (point) to the prow at the water line. The ram was used in battle to break through the hull of enemy ships. About 700 B.C., the Greeks built some galleys with two *banks* (rows) of oarsmen on each side, one above the other. The two-banked galleys had much more speed and ramming power than vessels with one bank of oarsmen had. About 650 B.C., the Greeks invented the *trireme*. It had three lines of rowers on each side, one above the other.

The Greeks—and later the Romans—built the hull of their ships first, as the Egyptians had done. But they used more and tighter joints to fit the planks together. They also inserted a system of ribs to stiffen the hull. As a result, Greek and Roman ships had strong hulls.

PHOENICIAN AND GREEK SHIPS

The Phoenicians left no records of how their ships looked. The little that scholars know about these vessels comes from other ancient peoples. The Greeks, on the other hand, pictured their ships on pottery. The Phoenicians and Greeks both built broad, roomy cargo ships and long, narrow war galleys. The Greeks added a deadly ram to the galley's prow between 1000 and 800 B.C. About 650 B.C., they invented the greatest warship of ancient times, a three-banked galley called a *trireme*.



Roman Ships. The Romans became rulers of the Mediterranean region during the 100's B.C. They used chiefly the same kinds of ships the Greeks had used.

The Romans built up the largest merchant fleet of ancient times. Their biggest cargo ships carried grain from Alexandria, Egypt, to Rome. The largest of these ships measured up to 180 feet (55 meters) long and 45 feet (14 meters) wide. They could haul more than 1,000 short tons (910 metric tons) of cargo and as many as 1,000 passengers.

Roman cargo ships, like all freighters of ancient times, carried travelers because no ships were designed only for passengers. Travelers simply reserved space on any freighter going their way. The ships had a few cabins for important persons. The other passengers lived on the open deck. These people slept under little shelters that they set up each night.

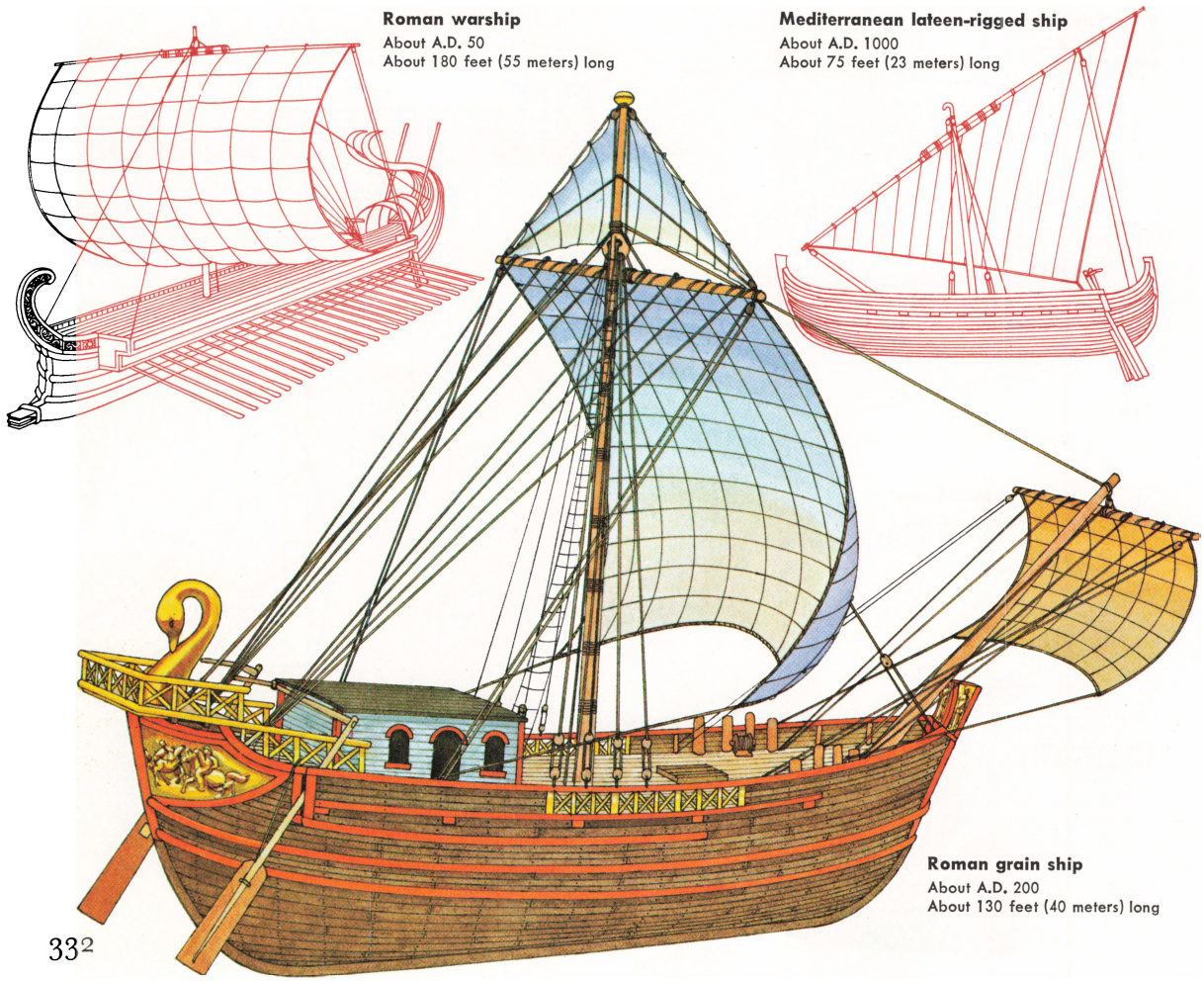
Viking Ships were the best vessels built in northern Europe between the A.D. 700's and the late 1000's. The bold Vikings sailed their famous long ships across the North Atlantic Ocean to Greenland and even to North America. They raided, traded, and colonized. As pirates, they were the terror of the seas.

We know much about the superb Viking ships because many Viking lords arranged to be buried in their boats. Scientists have found several such tombs. A well-preserved example of a Viking warship was uncovered in 1880 near Gokstad, in southeastern Norway. The Vikings built the ship about A.D. 900. It measures 78 feet (24 meters) long and 16 feet 9 inches (5.1 meters) wide. Like all Viking ships, the hull is *clinker-built*—that is, the planks overlap like siding on a house. The ship carried 16 oarsmen on each side. It had a square sail mounted on a mast probably 40 feet (12 meters) high and a steering oar near the stern. The Gokstad ship was small for a Viking ship. Most of these vessels had 20 oars on each side, and some had 30.

In 1893, a group of Norwegians built a full-scale replica of the Gokstad ship. They sailed it across the Atlantic Ocean from Bergen, Norway, to St. John's, Nfld., in only 28 days in spite of bad weather.

ROMAN SHIPS

The Romans mainly used the same kinds of warships and cargo vessels that the Greeks had used. But they also had a big, single-banked warship. The Romans built the largest merchant fleet of ancient times. Their biggest cargo ships brought grain from Egypt. The Romans, like the Greeks, used triangular sails called *lateens* on their smaller craft. The big freighters carried square sails. Widespread use of the lateen began in the Mediterranean area during the Middle Ages.



The Cog. The power of the Vikings gradually declined. By the late 1000's, they had lost control of the northern seas. Trade then began to increase among the countries of northern Europe. Merchants needed roomier vessels to carry larger shipments. By about 1200, shipbuilders in the north had developed a broad, sturdy ship called the *cog*. It became the standard merchant vessel and warship of northern Europe for about 200 years.

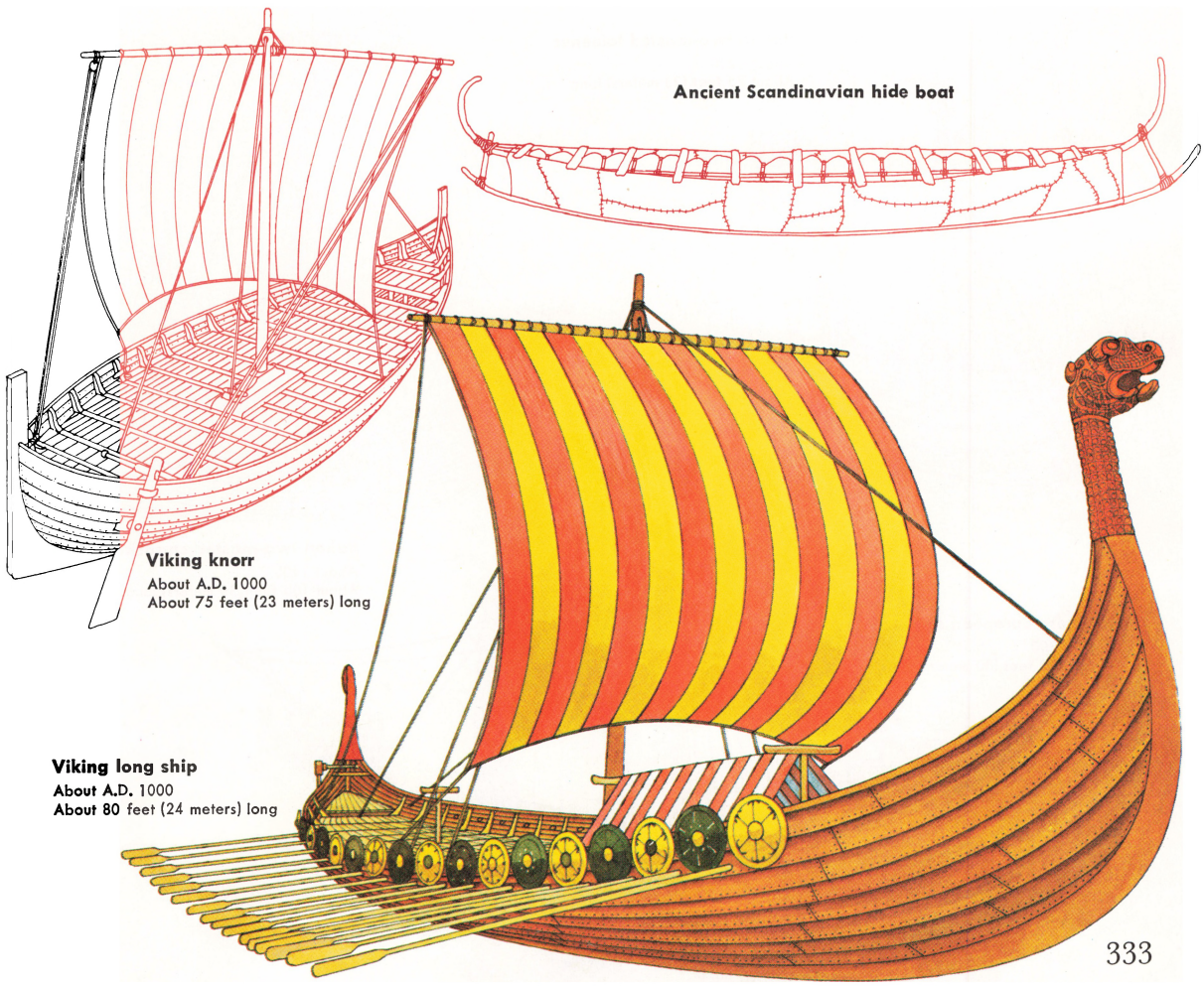
Cogs could stand up against the rough seas and high winds of the North Atlantic Ocean. Their deep, wide clinker-built hulls held bulky cargoes. These ships had one large square sail. They also had a high structure called a *castle* at the prow and the stern. The *forecastle*, at the prow, served as a platform from which marines could fire arrows and stones at enemy ships. The *sterncastle* provided a shelter for important passengers. Cogs also had a new kind of steering apparatus. Instead of steering oars along the sides near the stern, cogs had a large rudder in the middle of the stern. This rudder, which was introduced about 1300, was stronger than steering oars.

Lateen-Rigged Ships. While northern shipbuilders were developing the cog, Mediterranean shipbuilders were also making important changes in ship construction and design. The Mediterranean shipbuilders began a new way of shipbuilding that became standard. They built a skeleton of keel and ribs first and then fastened the planks of the hull to the framework. They also greatly increased the use of triangular sails called *lateens*. Square sails worked well with winds blowing from behind. But unlike lateen sails, they did not work well when sailing into the wind.

Galleys had always been used in the Mediterranean region as cargo and passenger ships as well as warships. But about 1300, the use of cargo and merchant galleys increased greatly. These galleys generally used their oars only when there was no wind and when entering or leaving a harbor. The rest of the time the vessels were driven by lateen sails. Most galleys had two masts, with the forward mast carrying the larger sail. Some

VIKING SHIPS

The people of Scandinavia have a long tradition as seafarers. In ancient times, they built dugouts, hide boats, and boats of wooden planks. From these early craft developed the Viking ships—the best ships built in northern Europe between the A.D. 700's and the late 1000's. The Vikings built broad, roomy cargo ships called *knorrs*. But they are best known for their *long ships*. They sailed these swift, narrow vessels across the unknown waters of the Atlantic Ocean to North America.



had three masts. The merchant galleys were longer and wider than the warships. The standard galley could carry about 140 short tons (127 metric tons) of cargo.

The Full-Rigged Ship. About the mid-1400's, Mediterranean shipbuilders combined the best features of the sturdy cog with those of their own lighter lateen-rigged vessels. The result was a sailing ship that became standard throughout Europe for about 300 years. The Mediterranean shipbuilders continued to build the hull by fastening the planking to a skeleton of keel and ribs. But they replaced the steering oars with a rudder in the stern. They also adopted the forecastle and sterncastle of the cog. Most important, they changed the rig to gain more power and better maneuverability—and so developed the full-rigged ship.

The basic full-rigged ship, or *square-rigger*, had a *mainmast* in the middle of the ship, a *foremast* in the forward part, and a *mizzenmast* in the back part. The mainmast and foremast each carried a big square sail and, above it, a smaller square sail. The mizzenmast held a lateen sail. A pole that stuck out from the bow carried a small square sail. During the late 1400's and 1500's, such great explorers as Christopher Columbus, Vasco da Gama, Sir Francis Drake, and Ferdinand Magellan used ships rigged in this way.

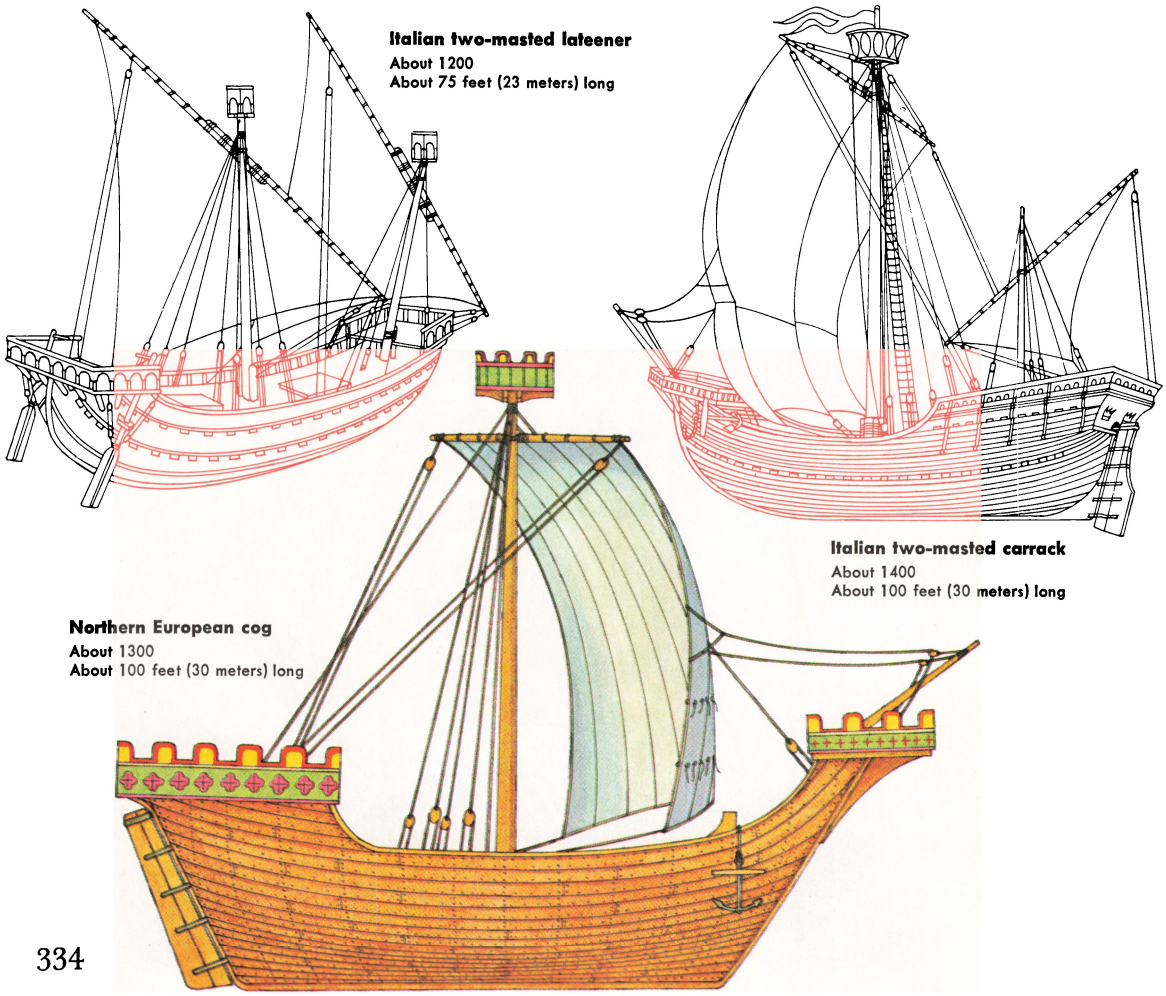
The new three-masted ships were relatively small and had few comforts. Only the captain, other high-ranking officers, and guests had cabins. The rest of the men slept on the deck or—after Columbus' first voyage to America—in hammocks below deck. The hammock was an American Indian invention that Columbus brought back to Europe.

The Galleon. About the mid-1500's, a type of sailing ship called the *galleon* appeared on the seas. Galleons were big vessels with a high sterncastle that housed elaborate living quarters. The foremast and mainmast each carried two or three sails, and the mizzenmast carried one or two. On the biggest galleons, a second mizzenmast was added near the stern.

Galleons served as both warships and cargo vessels. Guns had been used aboard ships since about the mid-

SHIPS OF THE 1200'S TO THE 1500'S

By about 1200, shipbuilders of northern Europe had developed the cog—a one-masted ship with a square sail and high castles at the prow and stern. About 1300, they invented the rudder. Meanwhile, Mediterranean shipbuilders had increased the use of lateen sails on all their craft, from small boats with one mast to big freighters with three masts. During the 1400's, they combined the best features of the cog and lighter lateener, producing two-masted and, finally, three-masted *carracks*.



1300's. But the galleons carried more and heavier guns. In 1588, the English and Spanish fleets fought one of the most famous sea battles in history. Both sides used galleons. But the English galleons were faster, more maneuverable, and better armed. They helped defeat the Spanish fleet. The Spaniards had called their fleet the *Invincible Armada* because they thought it could not be defeated (see ARMADA).

Spain, Portugal, and other countries also used galleons for trading. Spain used them to bring back gold and silver from its possessions in the New World. These treasure ships became a favorite target of pirates who roved the waters of the West Indies.

East Indiamen. For centuries, ships had served as both cargo vessels and warships. But by about the 1600's, guns and cannons had become so heavy that ships needed specially built hulls to carry the added weight. The design of warships and cargo vessels thus became, in time, greatly different.

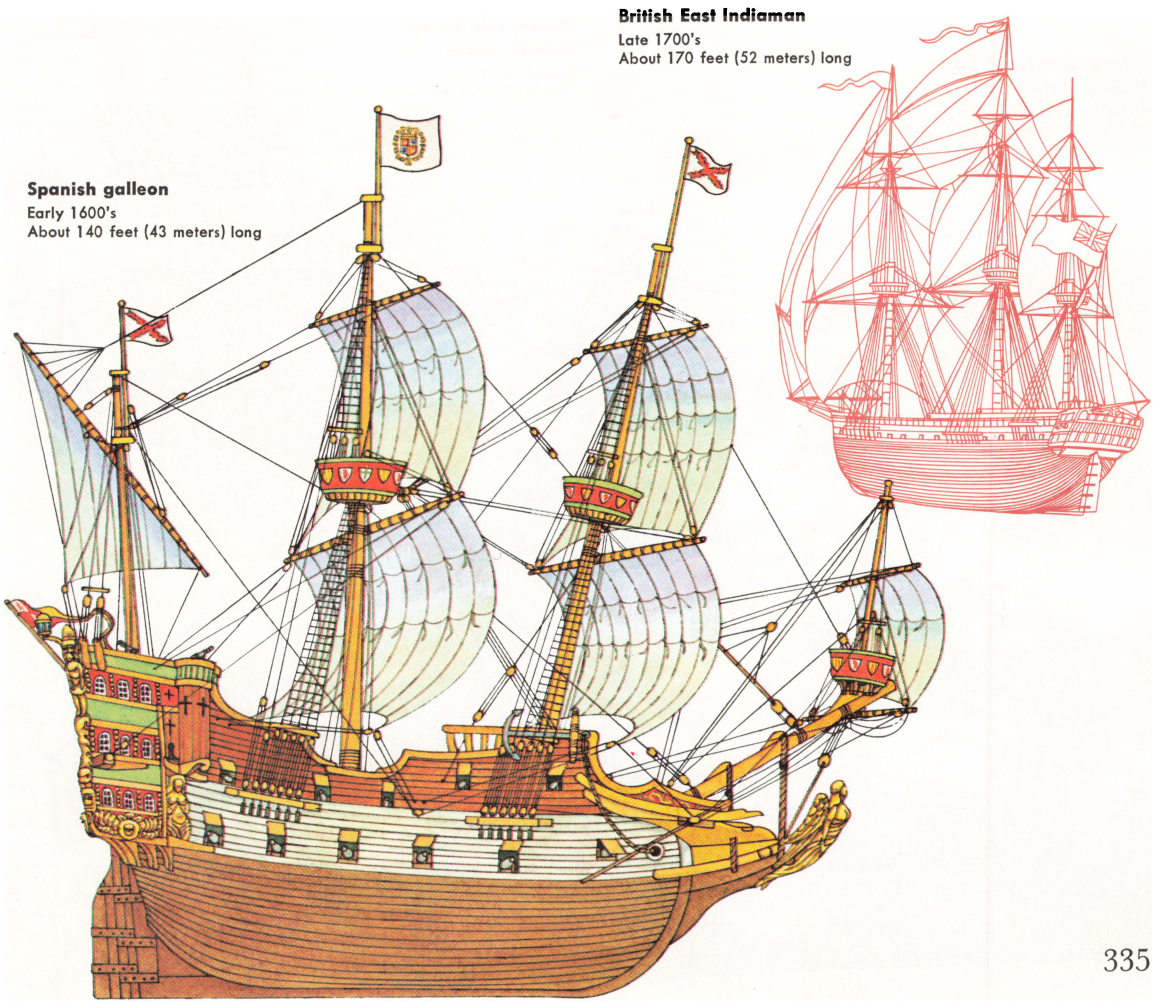
During the 1600's, trading companies in several European countries began to build merchant ships especially for trade with India and the Far East. These ships brought ivory, silks, spices, and other products from India, China, and the East Indies. The Portuguese controlled the trade with the Far East until about 1600, when England began to compete. Then The Netherlands, Denmark, and France also moved in. East India companies in each country built their own special ships, which were called *East Indiamen*. Although the Indiamen were designed as cargo carriers, they were partly warships. They had to carry guns against attacks by pirates and by the fleets of enemy countries.

The size of the East Indiamen grew steadily larger. In 1700, for example, most English Indiamen carried 400 short tons (360 metric tons) of cargo. By 1800, they carried 1,200 short tons (1,090 metric tons).

Packet Ships. By the early 1800's, trade between the United States and European countries had increased tremendously. But even more important, a great demand had developed for better transatlantic passenger service. American shipowners met the demand by offer-

SHIPS OF THE 1500'S TO THE 1800'S

Galleons **appeared on the seas about the mid-1500's. These big ships had high sterncastles and two or three sails on the foremast and mainmast and one or two sails on the mizzenmast. Galleons served as both warships and merchant ships. During the 1600's, European trading companies began to build special ships called *East Indiamen* for the rich trade with India and the Far East. These large, roomy ships carried guns against attacks by pirates and by the fleets of enemy countries.**



ing something entirely new in service—ships that sailed on regular schedules. Such vessels are called *packet* ships. Before this time, ships sailed only if they had a full load of cargo and passengers. In addition, the weather generally had to be favorable. Packet ships sailed at a scheduled time, fully loaded or not and regardless of the weather. The packets also became the first merchant vessels to stress the comfort of passengers. Packet service began in 1818. The Black Ball Line started the service, which was so successful that other American lines, such as Red Star and Swallow Tail, quickly followed.

To meet the schedules and the competition, the packets had to sail as fast as possible. But the ships themselves were ordinary sailing vessels that did not have especially sharp lines for speed. Their speed came from their captains, who drove the ships furiously night and day in all weather. The eastward crossing—from New York City to Liverpool, England, for example—took from three to four weeks. The westward crossing took longer—from five to six weeks—because the ships had to sail against the westerly winds.

The first packets measured about 100 feet (30 meters) long. By the 1840's, as passenger accommodations became larger and more comfortable, ships 160 feet (49 meters) long had come into use.

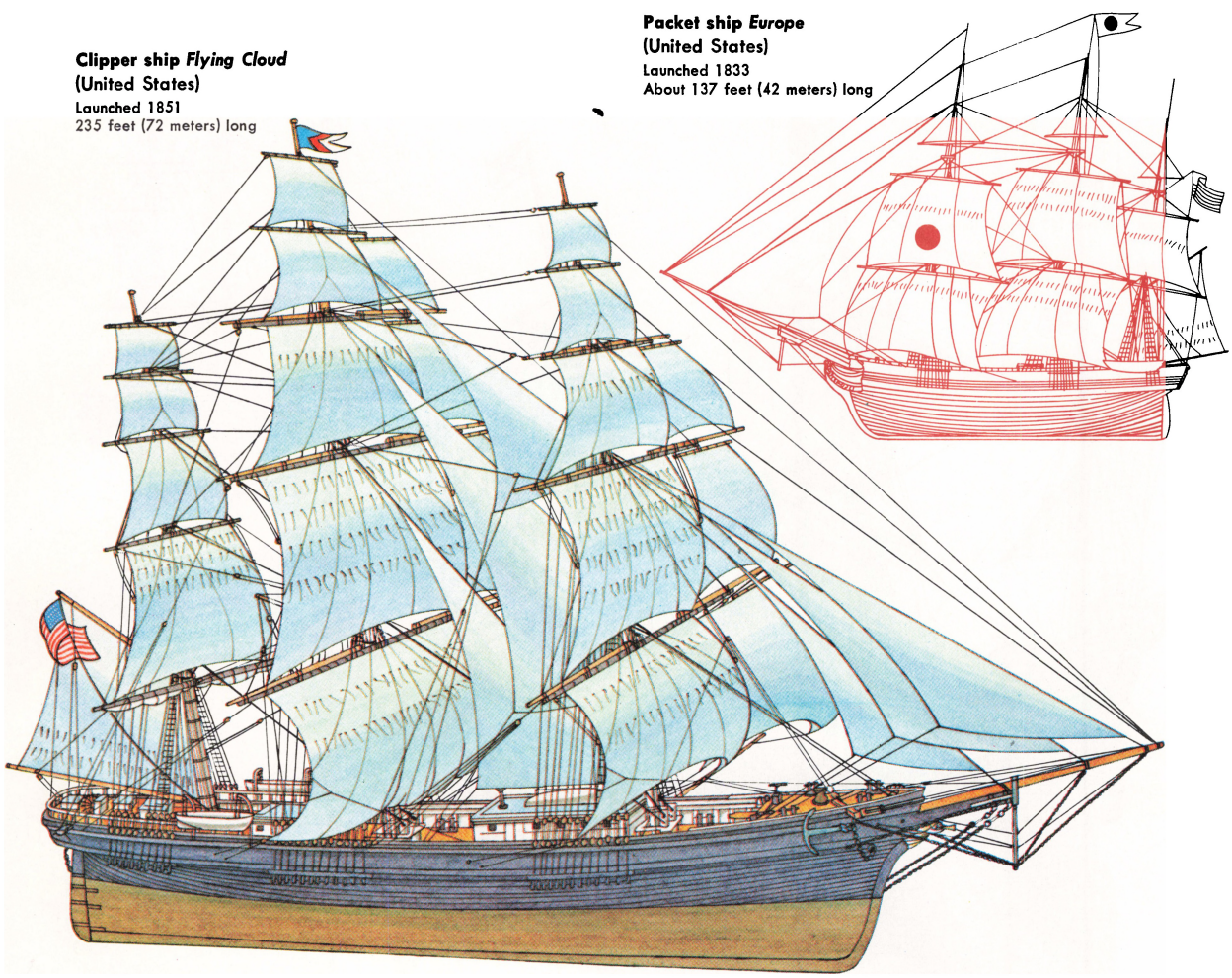
Clipper Ships, the most beautiful and romantic of all sailing ships, became the queens of the seas during the mid-1800's. The clippers, with their slender hulls and many sails, were designed for speed. Their name came from the word *clip*, meaning *to move swiftly.*

The United States built the first clippers in the 1840's. They were designed to sail from the East Coast, around the tip of South America, to China and bring back tea. The discovery of gold in California in 1848 and in Australia in 1851 hastened the clipper's development as fortune seekers and supplies were rushed to the gold fields. The success of the American clipper ship led the British to build a fleet of clippers to carry tea from China and wool from Australia.

Clippers had as many as six rows of sails to a mast. Some ships had as many as 35 sails. Driven at top speed,

SHIPS OF THE 1800'S

The most famous ships of the 1800's included the *packets* and *clippers*. Packet ships began to cross the Atlantic Ocean about 1818. They sailed on regular schedules whether or not they were fully loaded. Clipper ships appeared during the 1840's. They brought tea from China and wool from Australia and carried passengers around Cape Horn to California during the gold rush of 1849-1857. The swift clippers, with their many sails and slender hulls, could speed through the water at 20 knots.



clippers could cut through the water at 20 knots. They could race from New York City, around South America, to San Francisco in less than 100 days.

Donald McKay, a Canadian, became the greatest designer of clipper ships. His shipyard in East Boston, Mass., turned out more than 30 of them. McKay's first clippers measured about 200 feet (61 meters) long and could carry 1,500 short tons (1,360 metric tons). He steadily increased the size of his ships. In 1853, he launched the *Great Republic*, the largest wooden ship ever built. It was about 335 feet (102 meters) long, had four masts, and could carry more than 4,500 short tons (4,080 metric tons).

Sailing Ships in the 1900's. Inventors began experimenting with steam-powered boats in the late 1700's. By the early 1900's, the steamship had nearly replaced the oceangoing sailing ship. But coal-burning steamships had to depend on refueling stations, and certain trade routes—such as those along the coasts of South America—had few refueling stations. On these routes, sailing ships still had use. For many years, for example, sailing ships carried *nitrate*, a fertilizer, from Chile, around the tip of South America, to Europe.

The sailing ships launched during the late 1800's and early 1900's were huge vessels built for strength, not for speed. They had strong, straight-sided steel hulls and wire rigging. To operate cheaply, they used small crews and, therefore, carried a minimum amount of sail. Most of the ships had three masts. The mightiest of these great steel sailing ships was the *Preussen*, a five-masted, full-rigged German vessel built in 1902. It was the largest sailing ship ever built. The *Preussen* measured 433 feet (132 meters) long and 54 feet (16 meters) wide and could carry 8,000 short tons (7,300 metric tons) of cargo.

Since the early 1900's, the number of seagoing sailing ships has declined steadily. Many have rotted or rusted away at their docks. Today, most of the few remaining square-riggers serve as training ships for cadets in the navies and merchant marines of various countries.

In underdeveloped countries, people still use sailing ships for coastal and inland shipping. Many centuries ago, the Chinese developed the *junk*, a sturdy wooden vessel that carried its sails parallel to the length of the ship. The Chinese still use junks to carry goods and passengers along coasts and on rivers. For hundreds of years, the Arabs have sailed the Red Sea in long, slim, lateen-rigged vessels called *dhows*. Various Indian versions of the dhow are common in the harbors of Bombay, Calcutta, and other port cities of India. The people of New Guinea have long used a primitive sailing vessel called a *lakatoi*, which consists of several dugouts lashed together. Two-masted sailing ships called *schooners* carry cargo along the eastern and southern shores of the Mediterranean Sea. Schooners and single-masted vessels called *sloops* sail between Panama and Ecuador and along South America's west coast. The fishing fleets of underdeveloped countries consist mostly of sailing craft.

The Age of Engine-Powered Ships

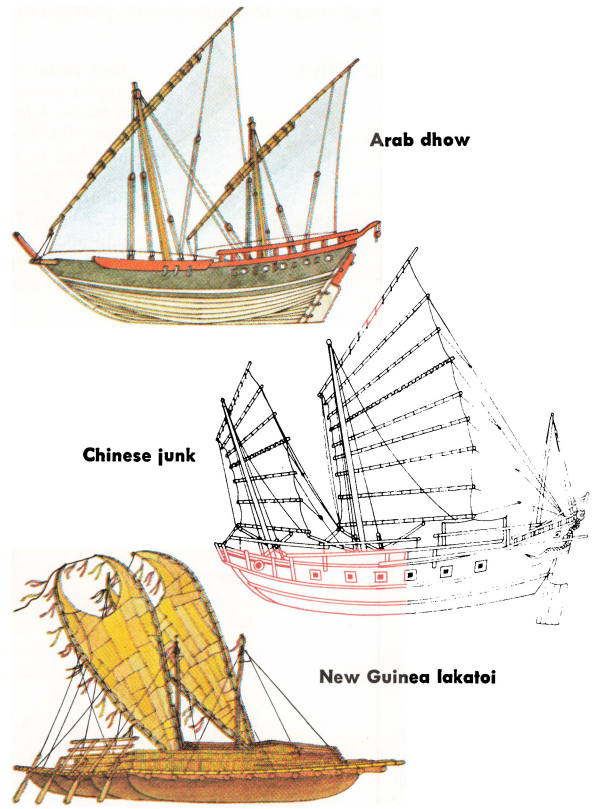
The invention and development of the steam engine revolutionized water transportation. Man no longer had to depend on his muscles or the uncertain wind to propel his ships. In 1769, James Watt, a Scottish engineer, patented a steam engine that could do many kinds of work. Inventors in Europe and the United States soon tried to use the engine to power boats.

The First Steamboats. In 1783, the Marquis Claude de Jouffroy d'Abbans, a French nobleman, built a steamboat that made a 15-minute trip on the Saône River near Lyon. But the marquis was never able to repeat his success. In 1787, John Fitch, an American inventor, demonstrated the first workable steamboat in the United States. Its engine powered a series of paddles on each side of the boat. Fitch later developed a vessel pushed by paddles at the stern. With this boat, he started the nation's first commercial passenger and freight service during the summer of 1790. He sailed the boat on schedule up and down the Delaware River between Philadelphia, Pa., and Trenton, N.J. But Fitch lacked enough money to keep operating. In 1802, William Symington, a British engineer, built a steam tug that had a paddle wheel at the stern. The tug worked perfectly, but Symington also ran out of money.

The *Clermont* became the first commercially successful steamboat. Robert Fulton, an American, designed and built the vessel. Fulton did not try to construct an

SAILING SHIPS OF THE 1900'S

Few seagoing sailing ships are used today. But in underdeveloped countries, people still use sailing ships for coastal and inland shipping and for fishing. These ships include the lateen-rigged *dhow* of Arabia, the sturdy wooden *junk* of China, and the *lakatoi* of New Guinea, known for its sails shaped like crab claws.



engine himself, as earlier inventors had done. Instead, he ordered one from Watt and adapted it to his boat. In 1807, the *Clermont* steamed 150 miles (241 kilometers) up the Hudson River from New York City to Albany in 32 hours. After some alterations, the boat sailed in regular passenger service on the Hudson. The *Clermont* was long and slender—about 140 feet (43 meters) long and 15 feet (4.6 meters) wide. It had side paddle wheels 4 feet (1.2 meters) wide and 15 feet (4.6 meters) in diameter. Fulton later designed 20 other steamboats, all of which made money.

Oceangoing Steamships. Fulton's boats puffed along only on quiet bays and rivers. In 1809, the *Phoenix* became the first steamboat to make an ocean voyage. John Stevens, an American engineer, built the boat. The *Phoenix* traveled along the Atlantic coast and up the Delaware River from New York City to Philadelphia. The trip took 13 days. Sailboats could do it in 2 days. In 1819, an American vessel, the *Savannah*, became the first steamship to cross the Atlantic Ocean. The *Savannah* was actually a full-rigged sailing ship equipped with steam-powered side paddle wheels. The ship took 29 days to travel from New York City to Liverpool. During the voyage, the *Savannah* ran its engine about 85 hours, using up its entire fuel supply of 75 short tons (68 metric tons) of coal and 25 cords (91 cubic meters) of wood. In 1838, the British side-wheeler *Sirius* became the first ship to cross the Atlantic under steam power alone. The trip took 18½ days.

Ships of Iron. During the late 1700's, British shipbuilders had begun to construct iron vessels, partly because good wood for ships was becoming scarce in Great Britain. But iron ships also had many advantages over wooden ones. They were stronger, safer, more economical, and easier to repair. In addition, iron ships were lighter than wooden ships of the same size, because wooden ships required huge, heavy timbers. As a result, iron ships could hold more cargo.

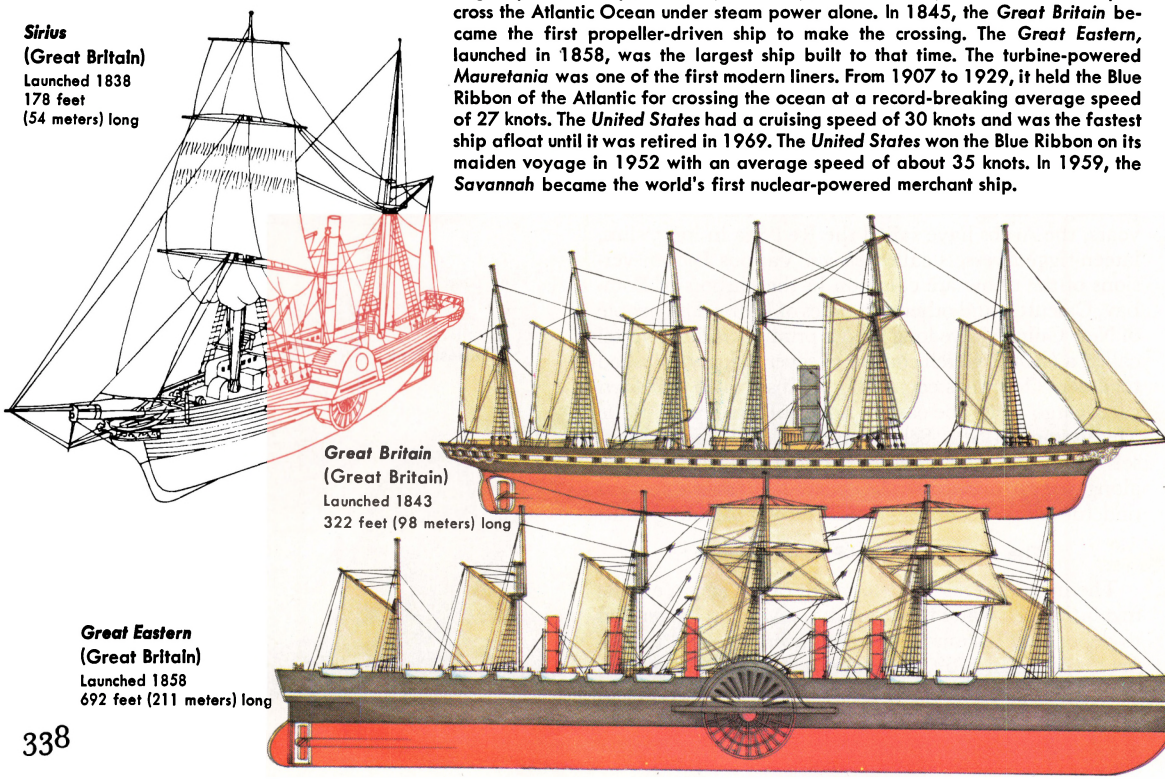
Great Britain led the world in the development of iron seagoing ships. In 1818, Britain launched the *Vulcan*, the first known all-iron sailing ship. In 1821, it launched the *Aaron Manby*, probably the first all-iron steamship. Britain's most gifted naval architect of the mid-1800's was Isambard Kingdom Brunel. In 1838, he built the *Great Western*, the first steamship designed especially for Atlantic crossings. The *Great Western* measured 236 feet (72 meters) long and 35 feet (11 meters) wide. Its huge side wheels drove the vessel at 9 knots. Brunel designed ever-larger ships. In 1858, he completed the *Great Eastern*, the most spectacular ship built to that time. It measured 692 feet (211 meters) long and about 85 feet (26 meters) wide and accommodated 4,000 passengers. But the ship failed economically. It did not attract enough customers to pay the enormous operating costs. During the 1860's, the *Great Eastern* was used in laying the first successful transatlantic telegraph cable across the ocean floor. In 1888, the ship was sold for scrap.

During the late 1800's, steel began to replace iron for ships. Steel ships were stronger and lighter than iron ones. In 1881, the *Servia*, a British vessel, became the first all-steel passenger liner to cross the Atlantic.

Development of the Ship Propeller. In 1836, two inventors—Francis Pettit Smith of England and John Ericsson of Sweden—each patented a propeller that

ENGINE-POWERED SHIPS

Each vessel shown below and on the next page made history in the development of engine-powered ships. In 1838, the *Sirius*, a side-wheeler, became the first ship to cross the Atlantic Ocean under steam power alone. In 1845, the *Great Britain* became the first propeller-driven ship to make the crossing. The *Great Eastern*, launched in 1858, was the largest ship built to that time. The turbine-powered *Mauretania* was one of the first modern liners. From 1907 to 1929, it held the Blue Ribbon of the Atlantic for crossing the ocean at a record-breaking average speed of 27 knots. The *United States* had a cruising speed of 30 knots and was the fastest ship afloat until it was retired in 1969. The *United States* won the Blue Ribbon on its maiden voyage in 1952 with an average speed of about 35 knots. In 1959, the *Savannah* became the world's first nuclear-powered merchant ship.



Sirius
(Great Britain)
Launched 1838
178 feet
(54 meters) long

Great Britain
(Great Britain)
Launched 1843
322 feet (98 meters) long

Great Eastern
(Great Britain)
Launched 1858
692 feet (211 meters) long

could drive steamboats more efficiently than paddle wheels could. The side paddles had worked well in calm waters. But in rough seas, as a ship rocked from side to side, one wheel and then the other might stick completely out of the water, wasting power. In addition, waves easily damaged the fragile wheels. A ship propeller, wholly under the water at the stern, used power more efficiently than the paddle wheels did. As the propeller bit into the water, it also pushed the ship forward much faster. In 1845, the *Great Britain*, designed by Brunel, became the first propeller-driven ship to travel across the Atlantic.

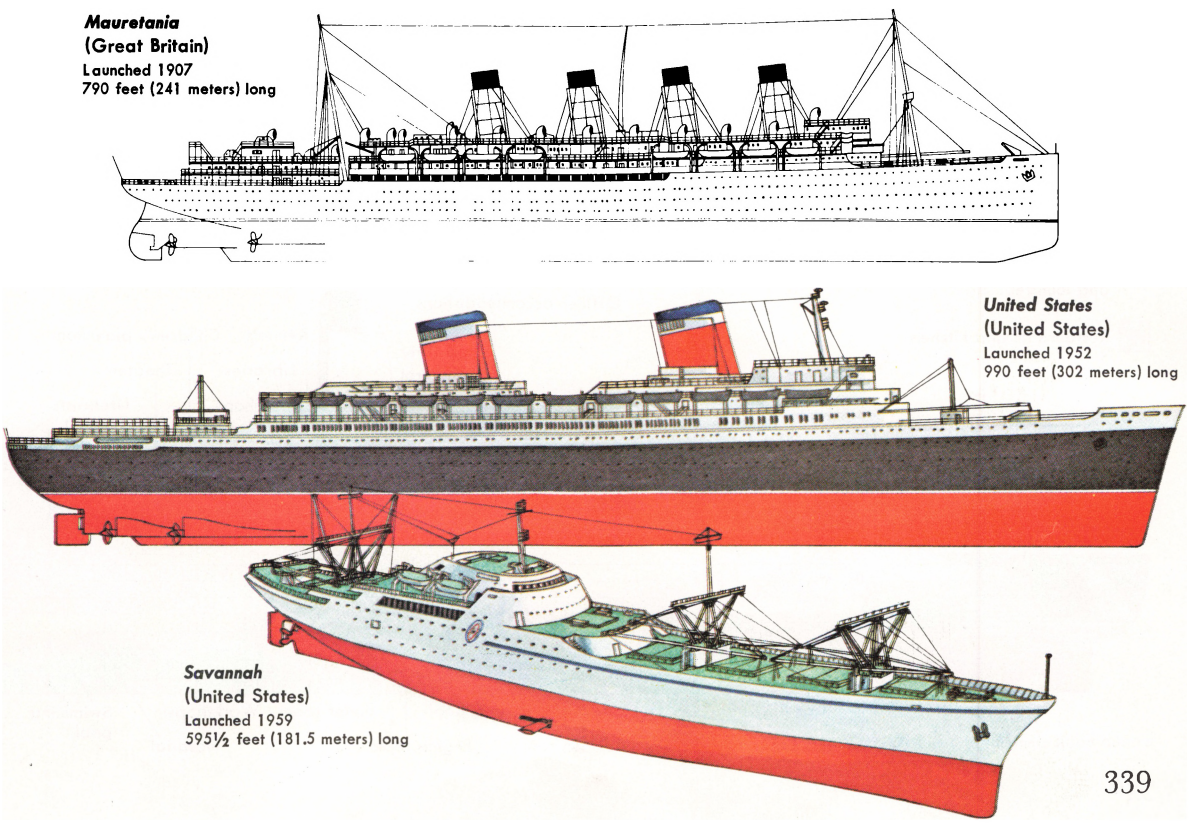
Increasing Power and Speed. New types of engines and new sources of power were developed as ships changed from wood to steel and from paddle wheels to propellers. Until the late 1800's, ships used a one-cylinder steam engine. The steam expanded in the cylinder, drove the piston a full stroke, and then passed to a condenser, where it was converted back to water. During the late 1800's, the *compound* steam engine, which had two cylinders, began to be used on ships. In the compound engine, steam pushed the piston in one cylinder and then passed on to a second, smaller cylinder. The engine thus created much more power from the same amount of steam and so cut the use of coal on ships up to 50 per cent. Later, shipbuilders installed three-, four-, and five-cylinder engines on their ships.

In the 1890's, Charles A. Parsons, an English engineer, designed a marine *steam turbine*, a completely new type of marine engine. It was much more powerful and efficient than the steam engine. In 1897, Parsons installed three turbines in his launch, the *Turbinia*, and raced up and down the River Thames at an amazing 34½ knots. Within a few years, fast luxury liners began crossing the Atlantic Ocean powered by steam turbines. One of the most famous of these liners was the British ship *Mauretania*, launched in 1907. It was 790 feet (241 meters) long and had a speed of 27 knots.

While Parsons was working on his steam turbine during the 1890's, Rudolf Diesel, a German mechanical engineer, was perfecting another new type of engine. It used heavy oil as fuel. His engine, now called the *diesel engine*, used less fuel than the turbine and required much less space on a ship. In 1910 and 1911, the first diesel-powered ships, which are called *motorships*, went into operation. Beginning about 1920, oil also began to replace coal as fuel for steam turbines. Today, most steamships use oil.

Nuclear Power and Automation. In 1954, the United States launched the world's first nuclear-powered ship, the submarine *Nautilus*. In 1959, the United States launched the *Savannah*, the first nuclear-powered merchant ship. It was retired in 1971. During the 1960's, West Germany and Japan also built merchant ships powered by nuclear energy. But nuclear merchant vessels are still impractical for commercial use because of their high building and operating costs.

Ships today have become increasingly automated. On many modern vessels, for example, electronic equipment controls the flow of fuel oil and air to the furnace and of water to the boilers. Automatic navigation aids help keep ships on course. Ships have also become larger and larger, and entirely new types have been developed. The next section of this article discusses the kinds of ships used today and tells how they developed.



Until the late 1940's, the queens of the sea were the great oceangoing passenger liners. France, Germany, and Great Britain built most of these magnificent floating hotels. The liners stressed luxury and service. In addition to the regular deck and engine room hands, an army of cabin and dining room stewards, cooks and bakers, and other service workers staffed the liners.

Beginning in the late 1940's, airplanes began to carry more and more people across the seas. Today, relatively few passenger liners sail the oceans, and the queens of the sea have become the great cargo ships. These ships emphasize efficiency and economy.

Cargo vessels have become bigger and bigger, chiefly for economic reasons. For example, shippers have found it far cheaper to transport 100,000 short tons (91,000 metric tons) of oil in one huge tanker than in five smaller ones carrying 20,000 short tons (18,000 metric tons) each. Also, for economic reasons, shipbuilders have designed vessels that can be loaded and unloaded in a minimum amount of time with minimum labor. In addition, more and more cargo ships are being automated so they can be run by smaller and smaller crews.

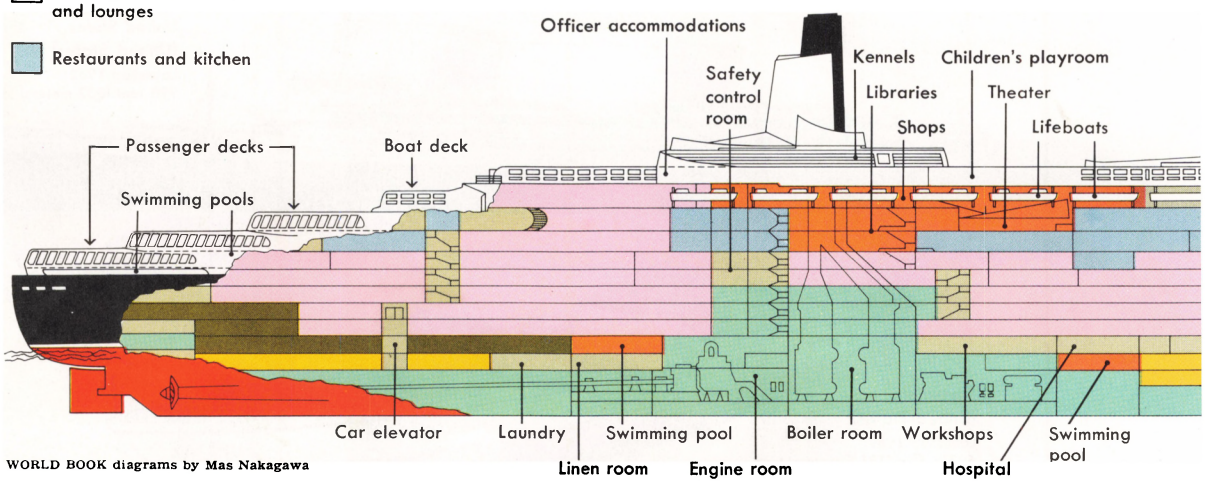
Passenger Vessels

The sailing packets that began to cross the Atlantic Ocean in the early 1800's were the first ships to stress

THE *QUEEN ELIZABETH 2*

The *Queen Elizabeth* 2 is one of the largest and most modern passenger ships. The British liner is 963 feet (294 meters) long. It was launched in 1967 and made its maiden voyage in 1969. It can carry over 1,700 passengers and has a crew of 900. The ship has a cruising speed of 28½ knots. The *Elizabeth* makes regular transatlantic crossings during the summer. In winter, it carries vacationists on cruises to the West Indies and the South Atlantic Ocean. The diagram below shows a cross section of the ship.

Queen Elizabeth 2 in New York Harbor—Cunard Line Ltd.



WORLD BOOK diagrams by Mas Nakagawa

passenger comfort. From then on, shipping companies provided better and better passenger services. As ships switched from sails to steam power during the 1800's, British companies offered the best accommodations, largely because of Brunel's excellently designed ships.

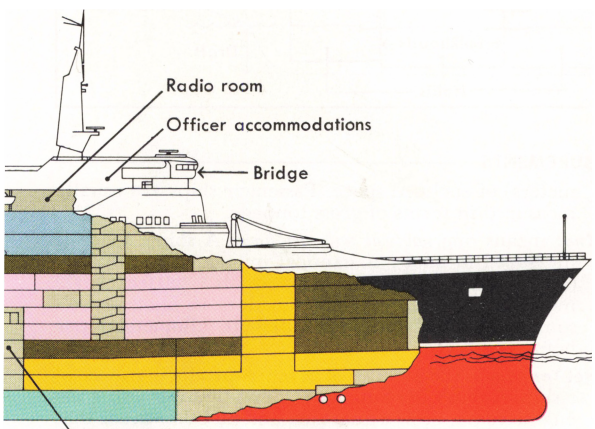
Two British firms—the Cunard Line and the White Star Line—dominated transatlantic service until about 1900. Then, Germany's North German Lloyd Line and Hamburg American Line began to offer serious competition. Later, French and Dutch lines entered the race for transatlantic passenger business. The United States took the lead in providing service across the Pacific Ocean with the founding of the Pacific Mail Steamship Company in 1848. As various shipping lines competed for passengers, ships became larger, faster, and more luxurious. They became ultramodern ocean liners.

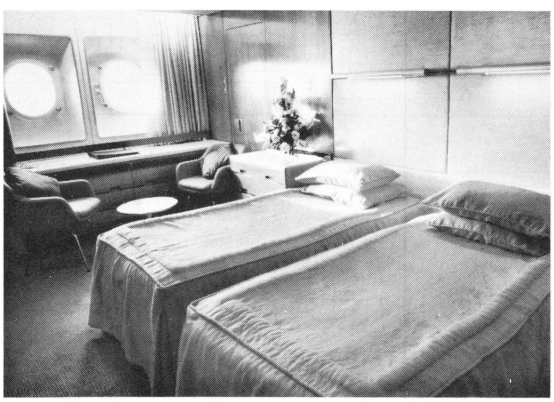
Ocean Liners. The great age of the ocean liner came during the early 1900's. The age reached its height in the 1930's with the launching of three of the most luxurious ships ever built. They were the *Normandie* of France and the *Queen Mary* and *Queen Elizabeth* of Great Britain. These giants, each more than 1,000 feet (300 meters) long, crossed the Atlantic Ocean in just over four days. In 1942, a disastrous fire destroyed the *Normandie* as it lay in New York Harbor.

Beginning in the late 1940's, the airplane began to

The Elegant Britannia Restaurant is one of three dining rooms on the *Elizabeth*. An enormous kitchen, with a staff of about 160 persons, serves the dining rooms and a 24-hour coffee shop.

Recreational Facilities include four swimming pools, a theater, and two libraries. The ship also has several bars and lounges, a nightclub, a variety of shops, and a children's playroom.





Cunard Line Ltd.

Passenger Accommodations on the *Elizabeth* consist of standard-class rooms, deluxe-class rooms, above, and luxury suites. All rooms are air-conditioned and have a toilet and a bath or shower.

NAUTICAL TERMS

Abaft means to the rear of. For example, abaft the mainmast means to the rear of the mainmast.

Aft means toward, at, or near the stern. To go aft is to go toward the stern.

Amidships means in the middle part of a ship, halfway between the bow and stern.

Ballast is the seawater or any other substance carried in the deepest holds to help keep the ship stable.

Beam is the width of a ship at its widest point.

Below means under the main deck. To go below means to leave the main deck and go anywhere beneath it.

Binnacle is the stand that holds a ship's compass.

Bow is the front part of a ship.

Bridge is the elevated platform above the main deck from which a ship is navigated.

Bulkheads are walls that divide a ship into compartments.

Bulwarks are low metal walls built around the main and upper decks. Bulwarks help prevent waves from breaking over the decks. They also help keep people or objects from falling or being washed overboard.

Companionway refers to the steps that lead from one deck to another.

Crow's-Nest is a small platform high on a mast from which a seaman keeps his lookout.

Derricks are lifting devices that lower cargo into or hoist it out of the holds.

Draft is the depth of a ship in the water—the distance from the water line to the bottom of the keel.

Forecastle (pronounced *FOHK suhl*) is a raised deck near the bow. The term also refers to the crew's quarters in the forward part of a ship.

Forward means toward the front of a ship.

Freeboard is the distance between the water line and the main deck.

Funnel is the smokestack of a ship.

Hatch is an opening in the deck through which cargo is lowered into or hoisted out of a hold. A *hatch cover* fits over the hatch.

Helm is a ship's steering wheel.

Holds are areas below deck in which cargo is stored.

Keel is the backbone of a ship. It is a ridge that runs along the lowest part of the hull from the stem to the stern.

Lee Side is the side of a ship away from the wind.

Moor means to keep a ship in place with ropes tied to a pier, to a buoy attached to an anchor, or to another ship.

Poop is a short raised deck at the rear of a ship.

Port is the left side of a ship when facing toward the bow.

Quarter refers to a section on each side of a ship near the stern.

Ship's Bell signals the time aboard ship. On most ships, a day consists of six 4-hour *watches* (periods when men stand duty). Officers and seamen have eight hours off duty after each watch. The watches change at 8 A.M., noon, 4 P.M., 8 P.M., midnight, and 4 A.M. A chime marks each half-hour. During a four-hour watch, one bell chimes at the first half-hour, two bells at the second, and so on up to eight, when the next watch begins and the sequence starts over again.

Starboard is the right side of a ship when facing the bow.

Stem is the foremost part of a ship.

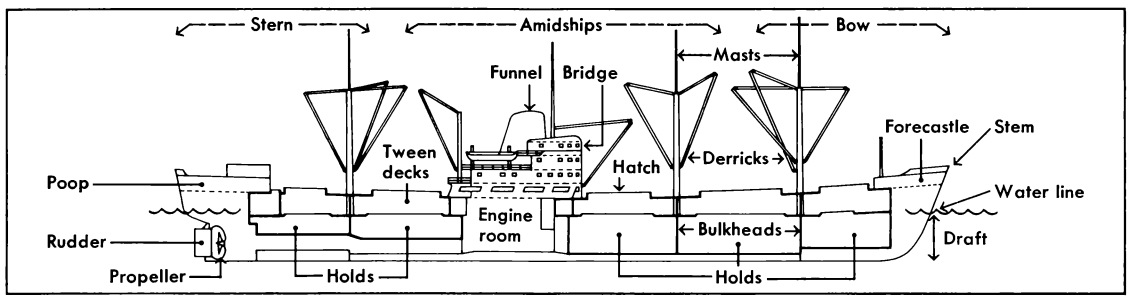
Stern is the rear part of a ship.

Superstructure consists of all the structures on a ship that rise above the main deck.

Tween Decks are spaces above the holds of general cargo ships in which additional cargo may be stored.

Water Line is the point on the hull that the surface of the water reaches.

Windward Side is the side of a ship from which the wind is blowing.



NAUTICAL MEASUREMENTS

Deadweight Tonnage is a ship's actual carrying capacity measured in long tons. A long ton equals 2,240 pounds (1,016 kilograms, or 1.016 metric tons). Deadweight tonnage includes cargo, crew, passengers, fuel, supplies, and spare parts. Freighters and tankers are generally described in terms of deadweight tonnage.

Displacement Tonnage is the number of long tons of water *displaced* (occupied) by a ship. This measurement is generally used for naval craft.

Gross Tonnage is the amount of a ship's enclosed space. It is a measure of volume, not weight, and is expressed in units of 100 cubic feet (2.8 cubic meters). A ship of 5,000 gross tons has 500,000 cubic feet (14,158 cubic meters) of enclosed space. Passenger ships are usually measured in terms of gross tonnage.

Knot means one *nautical mile per hour*. A ship's speed is measured in knots. A nautical mile equals 6,076 feet (1,852 meters), and a land mile equals 5,280 feet (1,609 meters). Therefore, a ship that does 10 knots travels somewhat faster than 10 miles (16 kilometers) per hour. See KNOT.

Net Tonnage is the amount of revenue-producing space of a ship. A ship's net tonnage is found by subtracting the engine room, crew's quarters, and all other areas that do not hold cargo from the gross tonnage. Net tonnage is used to determine harbor fees, taxes, and canal tolls.

Alan Band Associates

Air Cushion Vehicles ride on air just above the water's surface. The largest ones measure 130 feet (40 meters) long and can carry 600 passengers or 254 passengers and 30 automobiles.

attract more and more transoceanic passengers. Today, jet planes fly daily between the world's great cities. They cross the sea in hours, not days, and at about half the cost of an ocean trip. Most ocean liners cannot compete with the airplane and have given up. During the 1960's, Britain sold the *Queen Mary* and *Queen Elizabeth* to American investors who planned to make tourist attractions of the ships. In 1972, fire destroyed the *Queen Elizabeth* as it lay at anchor in Hong Kong Harbor. In 1952, American shipbuilders launched the *United States*, the pride of the nation's passenger fleet. The *United States* had a cruising speed of 30 knots and was the fastest ocean liner afloat. But in 1969, the ship stopped operating because of a lack of passengers. Today, the United States has no major passenger liner service across the Atlantic.

In spite of the competition from jet planes, some European shipping companies believe there will always be people who prefer to travel by ship. These companies have continued to build luxury liners as well as smaller cruise ships. The three largest transatlantic liners operating today were launched during the 1960's. They are two Italian ships, the *Michelangelo* and *Raffaello*, and a British vessel, the *Queen Elizabeth 2*. In winter, these and many other European ships are taken off their regular Atlantic crossings. They are used as cruise ships to the Mediterranean, the West Indies, and other winter vacation areas.

Other Passenger Vessels. Although the airplane has largely replaced the ocean liner for transoceanic travel, vessels for carrying passengers short distances over water have become increasingly important. Such short-distance vessels include car ferries, hydrofoils, and air cushion vehicles.

Car Ferries have carried automobiles and passengers across harbors, lakes, rivers, and other small bodies of water for many years. Like cargo ships, ferries have become bigger and bigger. Today, the biggest ones cross such large bodies of water as the Adriatic and Baltic seas and the English Channel. The largest car ferries can hold up to 800 passengers and 360 cars. They have dining rooms, lounges, and bars. Some ferries make overnight runs and have cabins for most passengers.

Hydrofoils provide high-speed transportation over relatively short distances. These vessels are mounted on skids that skim on or near the surface of the water. The hull remains completely out of the water, greatly reducing the drag caused by water resistance. Hydrofoils can race up to 60 knots. These vessels carry passengers across New York Harbor, on the Nile River of Egypt, across the Strait of Messina in Italy, and over other bodies of water in many parts of the world.

Air Cushion Vehicles also provide fast trips for short distances. Such vehicles are also called *hovercraft* or *ground effect machines*. Air cushion vehicles have a powerful horizontal fan that produces a strong, continuous thrust of air between the vehicle and the water or ground beneath it. The craft, which is driven by airplane-style propellers, rides on this cushion of air and can do 70 knots. Air cushion vehicles are especially popular in Great Britain, where they carry passengers on the River Thames, along the coasts, and across the English Channel to France.

Classification of Cargo Ships

Cargo ships, or freighters, can be divided into four groups, according to the kind of cargo they carry. These groups are (1) general cargo ships, (2) tankers, (3) dry bulk carriers, and (4) multipurpose ships. *General cargo ships* carry what are called "packaged" items—goods that are put in packages or that form a package in themselves. Packaged items include such products as chemicals, foods, furniture, machinery, motor vehicles, shoes, steel, textiles, and whiskey. *Tankers* carry petroleum or other liquid cargo. *Dry bulk carriers* haul coal, grain, iron ore, and similar products that can be loaded *in bulk* (loose) on the vessels. *Multipurpose ships* carry different classes of cargo—for example, liquid and general cargo—at the same time.

Cargo ships can also be divided into two types according to the service they offer shippers—*liner service* or *tramp service*. Cargo liners run on fixed schedules along certain trade routes and charge published rates. They usually transport only general cargo. Some cargo liners also carry passengers. Those that carry more than 12 passengers are called *combination* or *passenger-cargo* ships. These vessels must meet safety standards set up for passenger ships. Large shipping companies operate cargo liners. Tramp ships do not sail on regular trade routes or have regular schedules. They wander the sea lanes like taxicabs and can be hired to haul almost anything, anywhere, anytime. Small shipping companies and private individuals operate these ships.

General Cargo Ships

During the early 1900's, the standard general cargo ship was a *three-island* ship. Its name came from three structures that stood out above the main deck like separate islands. The forecastle, which held the crew's quarters, formed one island at the bow. The bridge,

from which the ship was navigated, formed the second island in the middle of the ship. The engine room was below the bridge. The poop, which held cabins for the officers and passengers, formed the third island at the stern. Hatches between the islands led to the holds beneath the deck where the cargo was stored. Each hold was a separate area with a hatch cover over it. The *derricks* (lifting devices) that loaded and unloaded each hold rose alongside the hatches.

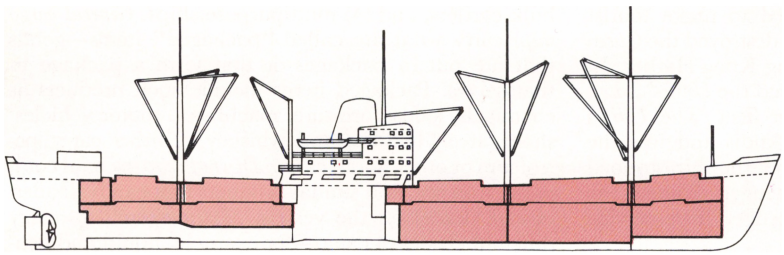
In time, the three-island ships gave way to freighters with one island, either in the middle of the ship or toward the stern. The island included the bridge and living quarters, with the engine room below. The one-island ship provided room for more and bigger hatches and so made it easier to load and unload cargo. During World War II (1939-1945), United States shipyards built more than 3,000 one-island ships—the famous Liberty and Victory ships. Both types of ships were about the same size, but the Victory ships, powered by steam turbines, were faster. The Liberty ships had reciprocating steam engines (see STEAM ENGINE [Piston Steam Engines]). Both ships were built according to standard plans so they could be mass-produced. They transported millions of troops and millions of tons of supplies to battlefields in every part of the world.

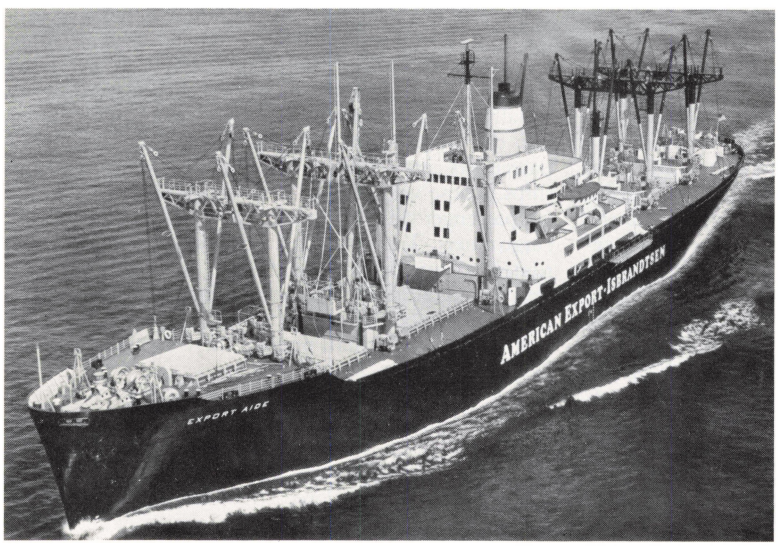
Traditional Cargo Ships. Since World War II, the traditional general cargo ship has steadily become more advanced. Today, it has powerful, electrically driven cranes and derricks. It can be loaded at the side and stern as well as at the hatches. It has automatic engine room controls and automatic navigation equipment. Yet the traditional general cargo ship has steadily been declining in use, chiefly because of high operating costs. A typical ship may carry automobiles, sacks of flour, cases of whiskey, television sets, airplane engines, crates of chinaware, and a variety of other items. Loading and unloading such a mixture of items of varying shapes and sizes requires much time and labor and is, therefore, expensive. As a result, the number of ships designed to carry only one type of cargo—tankers and dry bulk carriers, for example—has increased. Revolutionary versions of the general cargo freighter have also been developed. They include container ships, roll-on/roll-off ships, and LASH ships.

Container Ships eliminate the individual hatches, holds, and derricks of the traditional general cargo vessel. The hull of a container ship is simply an enormous warehouse divided into *cells* by vertical guide rails. The cells are designed to hold cargo in prepackaged units called *containers*. Most containers consist of a standard-

GENERAL CARGO SHIPS

General cargo ships carry "package" goods—that is, anything that can be put into a package or that forms a package in itself. Loading such cargo onto a ship and fitting the individual pieces into the holds require much time and labor—and are therefore costly.





Flying Camera, Inc.

The colored areas in the diagram, *above left*, indicate the cargo spaces of a general cargo ship. The picture, *left*, shows a modern vessel. Most cargo is swung aboard this type of ship on flat platforms called *pallets*, *above*, or in nets called *slings*. Derricks on the ship lift the cargo from the dock and lower it into the cargo spaces.

sized aluminum box that measures either 20 feet (6 meters) by 8 feet (2.4 meters) by 8 feet or 40 feet (12 meters) by 8 feet by 8 feet. A 40-foot container is about the size of a railroad car.

Manufacturers load their finished goods—anything from perfume to electronic products—into the containers, which are provided by the shipping company. They then have the containers delivered to the dock for loading onto the container ship. The ship does not need a large gang of men spending hours to fit various items into different holds. Giant cranes pick up the containers, swing them over the ship, and then lower them one upon the other into the cells. After the hold has been loaded, additional containers are stacked on the deck.

Containerization saves shippers much money. A container ship can be loaded and unloaded in a small fraction of the time it takes for a conventional cargo vessel. Thus, labor costs are cut sharply. There is also less breakage and less danger of cargo shifting during a voyage. In addition, there is far less theft of valuable merchandise because the containers are sealed.

The largest container ships measure about 700 feet (210 meters) long. They can carry over a thousand 20-foot (6-meter) containers that hold a total of about 12,000 short tons (10,900 metric tons) of cargo. These ships can make a round trip between Europe and the United States in 21 days. Because of this fast time, each of these ships equals the cargo-carrying capacity of 17 standard World War II freighters.

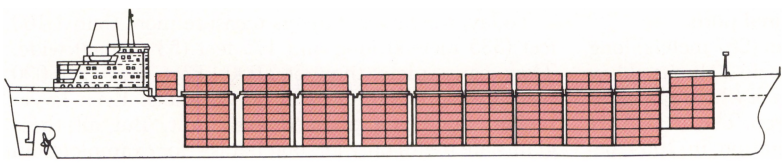
Many shipping companies believe that containerization is the greatest advancement in shipping since the invention of the steamship. Containerization of cargo began about the mid-1950's. Today, major shipping companies throughout the world operate or are building fleets of container ships.

Roll-On/Roll-Off Ships take containers mounted on a framework of wheels like a truck trailer. These ships have a stern opening and side openings. Dockworkers drive the containers up ramps onto the ships and then, by way of inboard ramps or elevators, take them to their assigned places on higher or lower decks. Roll-on/roll-off ships also haul cars, buses, house trailers, trucks, and any other cargo that can be rolled aboard. The world's largest roll-on/roll-off ship, the American vessel *Ponce de Leon*, went into operation in 1968. This ship is 700 feet (213 meters) long and does 25 knots. It can carry more than two hundred 40-foot (12-meter) containers and over 300 cars or trucks.

LASH Ships are huge freighters that carry preloaded seagoing *lighters* (barges) stacked one upon the other.

CONTAINER SHIPS

Container ships carry goods of all kinds in metal containers, most of which measure 8 feet (2.4 meters) deep, 8 feet wide, and 20 or 40 feet (6 or 12 meters) long. A container ship can be loaded and unloaded in about a fifth of the time it takes for a regular cargo ship.



Port of New York Authority

Flying Camera, Inc.

The colored areas in the diagram, *above left*, indicate the cargo space on a container ship. The picture, *left*, shows two fully loaded ships and the port facilities used to handle containers. Giant cranes on shore lift the containers from the dock and stack them one upon the other in the ship's *cells, above*.

Port of New York Authority

Roll-On/Roll-Off Ships carry automobiles, trucks, and any other cargo that can be rolled aboard through stern or side openings. Some of these ships are also equipped to handle containers.

Port of Antwerp

LASH Ships carry *lighters* (barges) preloaded with any kind of cargo. *LASH* means *L*ighter *A*board *SH*ip. Cranes on the carrier ship lift the lighters aboard, *foreground,* and unload them.

The term *LASH* stands for *L*ighter *A*board *SH*ip. The lighters are loaded at upriver ports with any kind of cargo and then towed by tugs to the seaport. There, cranes on the carrier ship lift the barges on board. The freighter then carries the barges to a seaport across the ocean. There, the barges are lowered into the harbor and then towed upstream to their final ports.

LASH ships measure up to 875 feet (267 meters) long and 107 feet (33 meters) wide and can do 20 knots. They can hold up to about 70 barges, each of which can carry 370 short tons (336 metric tons) of cargo. The first LASH ship, the *Acadia Forest*, began operation in 1969 between New Orleans, La., and Rotterdam, The Netherlands. An American line operates the Norwegian-owned ship.

Modernization of Ports. Container ships need special port facilities. Throughout the world, ports are being built or modernized to handle these vessels. The new facilities have giant cranes and other lifting equipment because container ships have few or no derricks. In port, the ships chiefly need large open areas where their thousands of containers can be left while awaiting loading or pickup. The most advanced ports use computers to assign the loading and pickup areas.

Tankers

Tankers were among the first ships designed to carry only one kind of cargo—petroleum. Earlier ships carried oil in barrels and then in large tanks. In 1878, Ludwig Nobel of Sweden launched a ship that was simply one great tank itself. Nobel was the brother of Alfred Nobel, founder of the famous Nobel prizes. His tanker hauled oil from the Baku fields in southeastern Russia across the Caspian Sea.

In 1866, the first oceangoing tanker, the *Glückauf*, was launched. This ship, built in Great Britain for a German oil company, carried petroleum from the United States to Europe. The *Glückauf* became the model for all later tankers. Its hold space was divided into eight big tanks, and its engine room was set in the stern to reduce the danger of fire. The vessel measured 300 feet (91 meters) long and 37 feet (11 meters) wide. It carried 2,300 short tons (2,090 metric tons) of oil and could travel 9 knots.

Today, the largest tankers measure more than 1,100 feet (335 meters) long and 175 feet (53 meters) wide. They carry more than 300,000 short tons (270,000 metric tons) of oil and can do 20 knots. Even larger tankers are being planned and built. But all these giants are useful only for long hauls—for example, from the oil fields of the Middle East, around the tip of southern Africa, to Europe.

The tanker *Manhattan* is the largest commercial ship ever built in the United States. This 1,005-foot (306-meter) vessel was launched in 1962 and can carry 115,000 short tons (104,300 metric tons). In 1969, it became the first commercial ship to crash through the ice-locked Northwest Passage along the Arctic Ocean coasts of Alaska and Canada. Men have dreamed for years of using the passage as a trade route. The *Manhattan* made the voyage to test the passage as a year-round route for hauling oil from Alaska's huge fields to the East Coast of the United States.

Most tankers carry petroleum. But some tankers are designed to haul other kinds of liquid cargo, such as cleaning fluids, fruit juices, liquid natural gas, molasses, vegetable oils, and wines.

Dry Bulk Carriers

Dry bulk carriers transport fertilizer, grain, ore, powdered detergents, salt, sugar, wood chips, or any other cargo that can be piled loose into a hold. The first modern bulk carriers included the specially designed boats that began hauling iron ore on the Great Lakes during the late 1800's. Like tankers, these vessels were designed to carry only one kind of cargo. But un-

like tankers, the ore carriers hauled solid cargo. As a result, they required more complicated loading and unloading arrangements than tankers, which needed little more than hose connections and pumps.

The Great Lakes ore carrier resembled a long steel box. It had a forecastle to accommodate the crew and bridge at the bow, and a poop to house the engines at the stern. Between the forecastle and the poop, there was a long bin to hold iron ore. Modern Great Lakes freighters have the same basic design, but they are larger than the earlier carriers. The largest vessels today are more than 700 feet (210 meters) long and carry up to 25,000 short tons (22,700 metric tons).

Oceangoing bulk carriers have also grown larger and larger. The biggest ones can carry more than 100,000 short tons (91,000 metric tons) of cargo. A modern seagoing bulk carrier has the bridge and engine room near the stern. The rest of the ship is a level area of deck with a line of hatches. Motor-driven equipment on board quickly removes the enormous hatch covers.

During the late 1950's, shipbuilders began to design vessels that could haul either ore or oil. These ships are called *O/O* carriers. During the 1960's, another new type of carrier appeared—the *O/B/O*. An O/B/O ship can haul ore; light bulk cargo, such as grain or fertilizer; or oil. The largest O/O ship can haul 250,000 short tons (227,000 metric tons) of cargo. The largest O/B/O vessels can carry up to 150,000 short tons (136,000 metric tons).

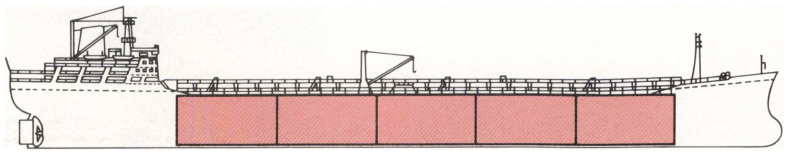
Barges are somewhat like small bulk carriers. These boxlike vessels haul such cargoes as cement, coal, grain, gravel, and sand across harbors, on canals and rivers, and along coasts. Before the invention of power-driven machinery, sails propelled most canal and river barges. In areas where the wind was unreliable, men or animals trudged along the bank of a canal or river and pulled the barges. In Egypt, India, and some other countries, barges are still towed in this way. Modern barges have diesel motors or are towed by tugs. The size of a canal or river barge is limited by the waterway on which it operates. The barge must be short enough to make the curves in the waterway and narrow enough to pass through canals. Barges that operate in coastal waters can be practically any size.

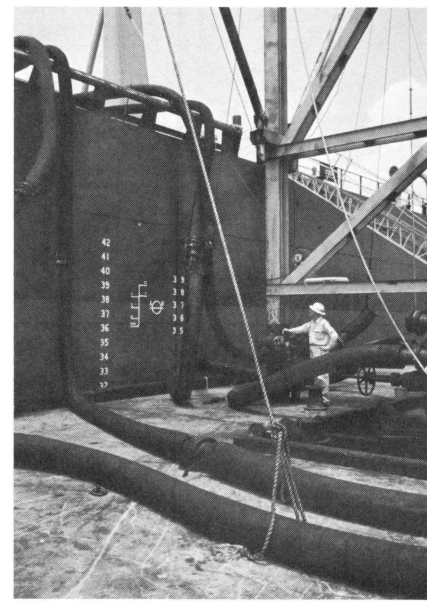
Multipurpose Ships

Multipurpose ships are designed to haul several kinds of cargo at the same time. An example is the British ship *Strathardle*, launched in 1967. It has refrigerated space for foods that spoil easily, tank space for liquid

TANKERS

Most tankers transport petroleum, but some are specially designed to carry other kinds of liquid cargo. The interior of an oil tanker resembles a huge ice cube tray. It is divided into separate tanks by bulkheads that run across the width and length of the ship.





Exxon Corporation

The colored areas in the diagram, *above left*, indicate the separate tanks that make up an oil tanker's cargo space. The picture, *left*, shows two modern tankers being loaded at an oil terminal and refinery. Petroleum is pumped aboard a tanker at oil terminals through large hoses, *above*. The ship's own pumps unload the oil.

cargo, and a deck for automobiles. The vessel is 563 feet (172 meters) long and 80 feet (24 meters) wide. Another multipurpose ship is the *Bore VI*, a small Finnish freighter also built in 1967. It hauls roll-on/roll-off vehicles, large rolls of paper, packaged lumber, and general cargo. This ship is 290 feet (88 meters) long and 49 feet (15 meters) wide. In 1968, the *Mormacsea*, the first American-built multipurpose vessel, was launched. It can carry containers, roll-on/roll-off cargo, and general cargo. It also has refrigerated space. The *Mormacsea* measures 602 feet (183 meters) long and 90 feet (27 meters) wide.

Specialized Types of Vessels

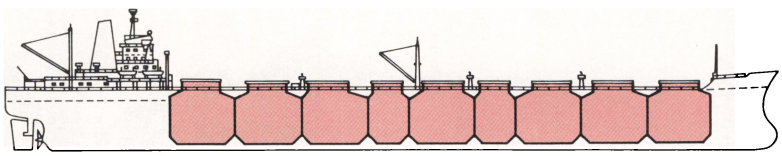
Many ships and boats have been designed to do particular jobs. Refrigerator ships, traveling 22 knots or faster, speed fresh fruits, meats, and vegetables across the ocean. Tugboats tow barges along canals and rivers and guide huge passenger liners and freighters in and out of harbors. Oceangoing tugs take part in rescue and salvage work. Besides ferries that transport automobiles and passengers, there are train ferries that carry railroad cars across small bodies of water. Powerful icebreakers use their sturdy bows to ram through frozen waters and open a path for other ships and boats. Oceanographic ships carry instruments to study currents, tides, waves, and the animals and plants of the sea. Some modern fishing vessels are used not only to catch fish, but also to process them. These ships have equipment to behead, clean, and refrigerate the fish.

Ships of the Future

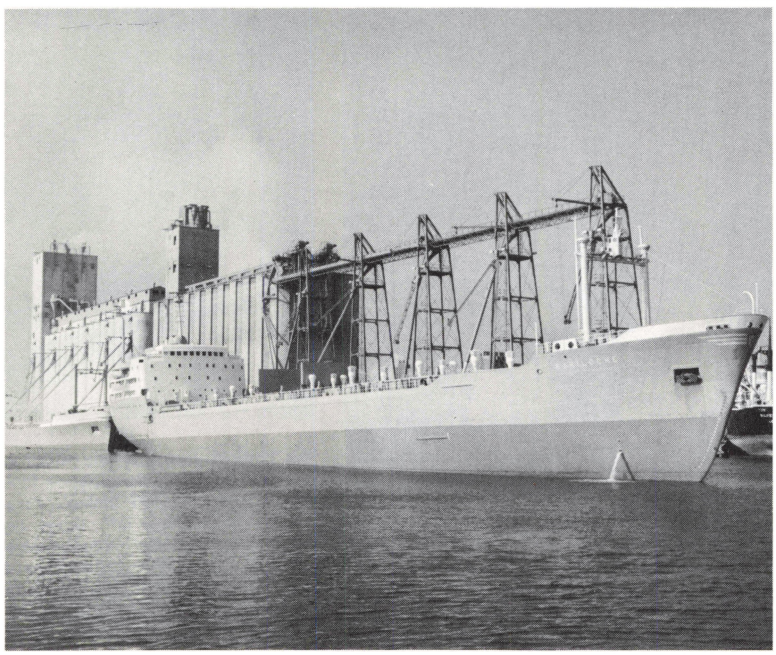
Future ships will be even more efficient than those of today and so will cost less to operate. More and more ships will carry containerized cargo, and all ships will be larger. Ships will become increasingly automated. A staff of engineers will no longer need to stand watch in the engine room. Instead, ship engines will be operated from the bridge, just as plane engines are run from the pilot's cabin. Electronic equipment will navigate tomorrow's ships automatically. A computer will determine a ship's course and, by sending the information to machinery that regulates the rudder, steer the vessel. As a result of these developments, ship officers will receive increased technical training. Crews will become smaller and smaller. Ship maintenance will no longer be done at sea by the crew, but in port by specialized workers. To avoid such maintenance work as painting, the bridge, cabins, and other structures on the main deck will be built of aluminum.

BULK CARRIERS

Dry bulk carriers haul grain, ore, and other cargo that can be loaded *in bulk* (loose). Bulk carriers called O/O ships carry ore or oil. O/B/O ships carry oil or ore or other dry bulk cargo. These *combination* ships do not haul oil and dry cargo at the same time.



Alabama State Docks



Kyodo News Service

The colored areas in the diagram, *above left*, indicate the holds of an O/B/O ship. The picture, *left*, shows two bulk carriers that haul grain. Most dry cargo is unloaded by shore-based suction devices or by power scoops, such as this one, *above*, unloading iron ore. Some bulk carriers, called *self-unloaders*, have built-in conveyors.

The Bridge of a Modern Ocean Liner has highly accurate navigation equipment for steering the ship and keeping it safely on course under all conditions. Such equipment includes radar, an automatic pilot, and a radio navigation system.

Cunard Line Ltd.

The Chart Room has various aids to plot a ship's course and position. One device, above, reproduces weather charts sent by radio.

The officers and crew of a ship work as a team to see that the passengers, the cargo, and the ship itself arrive at their destination safely and on time. To sail a ship long distances across open water requires great skill and experience. A change in the wind's strength or direction, or the force of the waves and currents, can put a ship off course. A ship's officers use equipment and methods developed hundreds of years ago—as well as modern devices—to tell where their ship is at all times.

Officers and Crewmen. A highly organized team of officers commands a ship. The top man is called the *captain* or *master*. He has final authority over and final responsibility for the passengers, crew, cargo, and ship. The captain has a number of deck officers, called *mates*, to assist him. He has at least a chief, or first, mate; a second mate; and a third mate. On large passenger ships, the captain may have one or two additional mates. All these officers must have a license, which they receive after passing a test given by a nation's government or some other authority. The U.S. Coast Guard issues licenses to officers on American merchant ships. The deck officers navigate the ship and command the deck crew.

The deck crew consists of *able-bodied seamen* (A.B.'s) and *ordinary seamen*. On American ships, both groups of seamen must hold certificates issued by the Coast Guard. Able-bodied seamen have more experience than ordinary seamen and have the more responsible tasks, such as standing lookout, helping steer, and making difficult repairs. Ordinary seamen do painting and other maintenance work.

The engine room has a separate organization. It is headed by a *chief engineer*, who is aided by first, second, and third *assistant engineers*. Like the captain and deck officers, all the engineers must have a license. The crewmen in the engine room of a ship driven by steam turbines include oilers, who help tend the engines, and firemen, who fire the boilers.

In addition to the deck officers, engine room staff, and seamen, a ship has a number of other crewmen. They include a chief radio operator; a chief steward, who is in charge of obtaining, preparing, and serving food; one or two cooks; and messmen, who serve the meals and assist the cooks.

Cargo and passenger ships carry the same basic groups of crewmen. But large passenger liners and cruise ships have much larger crews to make a voyage as pleasant as possible for the passengers. The extra crewmen include bakers, barbers and beauticians, bartenders, butchers, doctors and nurses, entertainers, laundrymen, printers, *pursers* (accountants), recreation directors, and a large staff of stewards and stewardesses. A big passenger or cruise ship may carry as many as 2,000 passengers and 1,000 crewmen—or one crewman for every two passengers.

Navigating a Ship. When a large ship leaves port, three or four small tugboats pull the vessel from the pier into the harbor. A *docking pilot* directs the tugs and the ship until the vessel clears the pier and is underway in the harbor. The tugs then leave the ship and the docking pilot turns the vessel over to a *harbor pilot*. Every ship enters and leaves port with a local harbor pilot aboard.

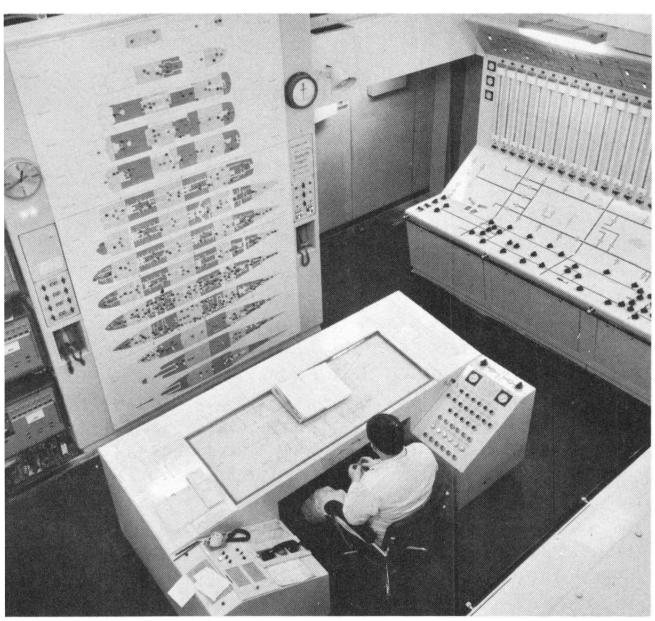
The harbor pilot guides the ship into the harbor or out into open water. Taking a large ship through a crowded harbor requires skill, experience, and expert

knowledge of the harbor. The harbor pilot must know every channel, turn, sand bar, or other obstacle that could endanger the vessel. After a ship reaches open sea, a small boat comes out and carries the pilot back to port. The ship's officers then take over the job of navigating the vessel to its destination.

On the bridge, the navigator, who on most vessels is the second mate, uses various equipment to locate the ship's position. As sailors have done for thousands of years, he checks its position by observing the sun, moon, planets, and stars. For hundreds of years, the most important navigation devices have included a *compass* to tell direction, a *chronometer* to tell the exact time, and a *sextant* to calculate a ship's position by measuring the angle of the sun or of a star above the horizon.

Today, modern ships also have highly accurate electronic navigation equipment. Many ships have devices for determining their position through radio signals. These signals are sent out continuously by special transmitting stations along the coasts of busy trade routes. One such system is called *loran* (*lo*ng *ra*nge *n*avigation). With loran, an accurate position can be obtained in bad weather and poor visibility without a compass, chronometer, or sextant. See LORAN.

Modern ships also carry radar. At night and in bad weather, a ship's radar can spot icebergs, rocks, and other vessels in time to prevent a collision (see RADAR). Some modern ships also have an automatic pilot, which, after a ship has been set on course, holds it there. This device is linked to the compass and operates the rudder automatically. In spite of all these remarkable devices, navigators still also use the tried-and-true compass, chronometer, and sextant, which have served seamen so well for so long. For more information on how ships are navigated, see NAVIGATION.



Cunard Line Ltd.

Safety at Sea includes measures to prevent and fight fire. An officer, *above*, sitting before a master plan of a modern liner, oversees controls that instantly report any outbreak of fire.

Automation Aboard Ships is increasing, but no ship is as yet completely automated. Most automation has been in the engine room. When the officer on the bridge signals the engines to go ahead or backward or to change speed, the engineer no longer has to make adjustments by hand. Instead, the engines respond immediately. The operation of the valves and the necessary change in temperature or pressure are taken care of automatically. More and more ships have automatic navigation aids and automatic devices to speed up the loading and unloading of cargo. Increased automation may make it possible for cargo ships of the future to have a crew of only 9 or 10 men.

Safety at Sea. Safety standards for ships have been set up by International Safety of Life at Sea conventions, which were held in 1914, 1929, 1948, and 1960. All the major maritime nations have agreed to these standards. The standards require that ships have watertight *bulkheads* (compartment walls); fire-fighting equipment; and enough lifeboats, life jackets, and other lifesaving equipment. Other rules provide that lifesaving and fire drills be carried out at regular intervals. In addition, ships must follow the International Rules of the Road. These rules deal with such points as the rights of way of ships on the high seas, the lights ships must show, and the signals they must give in fog and in times of distress.

In 1930, all the leading seafaring countries accepted rules set up by the International Load Convention to keep ships from being overloaded. These rules require that cargo ships have a series of short lines painted on their side to show the depth to which the vessels may be safely loaded at various times of the year and in various waters. When a ship, being loaded with cargo, sinks in the water to a certain line, it has reached the maximum load. The lines are called *Plimsoll marks*. They are named after Samuel Plimsoll, a member of the British Parliament who brought about their adoption in Great Britain in 1875. In 1966, the world's maritime nations agreed to new rules that raised the limits to which ships may be safely loaded. The new rules reflected improvements in ship design and construction since 1930. See PLIMSOLL MARK.

In addition to international maritime laws, individual countries have their own regulations governing the construction and operation of their own ships. The United States has especially high safety requirements. In many cases, its standards are far higher than international rules require. These strict standards have made American ships exceptionally safe. But they have also made U.S. ships much more costly to build and operate than foreign ships.

The U.S. Coast Guard sees that American vessels meet the standards set up by the federal government. The Coast Guard must approve the construction plans for each new ship. It inspects the ships during their construction to make sure that they are being built according to the plans. At regular periods, the Coast Guard also checks all merchant ships in active service to make sure that they meet all safety regulations.

A ship is one of the most complicated objects made by man. It is actually a floating city that generates its own power, heat, and electricity. A ship carries its own fuel and provisions. It can make its own fresh water from the sea, and it disposes of its own garbage.

All ships have four main parts. In designing a ship, naval architects plan these and other parts of the vessel so that it meets a shipping company's special needs as well as government safety regulations. A shipyard then builds the ship according to the architect's plans.

The Chief Parts of a Ship are (1) the hull, (2) the engines, (3) the propellers, and (4) the rudder.

The Hull is the watertight shell of a ship. It is divided into a number of horizontal surfaces called *decks*. *Bulkheads* are walls built between the decks, forming compartments. Each compartment has special doors that, when closed, make it watertight. If water floods one compartment because of an accident, closing the doors will trap the water there and prevent it from flooding other compartments. Watertight compartments enable a ship to float even with a hole in its hull.

The deck at the top of the hull is called the *main deck*. Several more decks may be above it. All the structures above the main deck make up the *superstructure*.

Hulls have a pointed bow so they can knife swiftly through the water. Most hulls also have a rounded stern, which helps the water close smoothly behind as the ship cuts through the water. The overall shape of a hull is designed to make the ship as *stable* (steady) as possible. A ship must not *roll* (rock from side to side) or *pitch* (rock from front to back) too much. Most modern ships also use stabilizing systems to reduce rolling. One such system has a horizontal underwater fin on each side of the hull. The fin moves upward on the descending side of the ship and downward on the ascending side and so reduces the roll.

To increase stability further, ships carry extra weight called *ballast*. Without ballast, an empty cargo ship would bobble about in the ocean like a cork. Most ships use seawater as ballast. As a ship takes on cargo, the ballast water is pumped out.

The Engines of most ships are steam turbines, gas turbines, or diesel engines. The largest and fastest ships have steam turbines. Steam produced in the boilers spins the bladed wheels of the turbine. The turbine, through a series of *gears* (toothed wheels), drives the propeller shaft and makes the propeller revolve. On turboelectric ships, the turbine turns a generator that produces electricity for a motor. The motor, in turn, drives the propeller. Almost all merchant ships use oil as the fuel to heat the boilers that create the steam. On nuclear-powered ships, an atomic reactor creates the steam. Many of the most advanced ships have gas turbines. Gas turbines work much like steam turbines but use hot gases instead of steam. See TURBINE.

Vessels propelled by diesel engines are called *motorships*. They have either *geared-drive* or *diesel-electric* machinery. On a geared-drive ship, the engine works through gears to turn the propeller. On a diesel-electric ship, the engine turns a generator that supplies current to an electric motor connected to the propeller shaft. See DIESEL ENGINE.

The Propellers, also called *screws*, move a ship through the water. The engine turns a shaft that juts out underwater from the stern. The propeller is bolted to the end of the shaft. Most propellers have four blades. As a propeller turns, it screws itself through the water and so pushes the ship forward. Most small ships have one propeller. Many larger vessels have two propellers, and very big ships have four. Additional screws increase a ship's power and make the vessel easier to maneuver. For example, a twin-screw ship can be swung around quickly by going forward on one propeller and backward on the other. See PROPELLER (Marine Propellers).

The Rudder is a large flat piece of metal that steers a ship. It is hinged to the stern and so can be swung like a door. The rudder is connected to the *helm* (steering wheel) on the ship's bridge. When the helmsman turns the wheel to the right, the rudder moves to the right, causing the stern to swing left and the bow to swing right. When he turns the helm to the left, the rudder and bow swing to the left.

Other Parts and Equipment of a ship include *funnels* (smokestacks) to discharge smoke and exhaust fumes, an anchor on the left and right sides of the bow, and enough lifeboats to hold all persons on board. Modern ships have power-driven *winches* to raise or lower the anchors and to bring in or let out the *mooring lines* used to tie vessels at a pier. Power-driven winches also operate the cranes for loading and unloading cargo. Modern ships also have high-speed pumps to pump out ballast water or to pump up seawater in case of fire. Radiotelegraph equipment keeps ships in constant touch with the rest of the world.

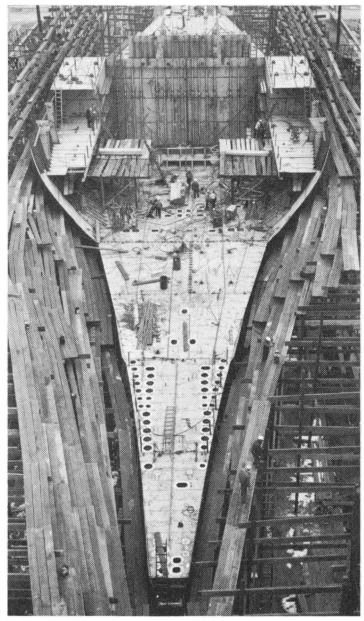
Designing and Constructing a Ship. Before a naval architect begins to design a ship for a shipping company, he must know how the firm plans to use the vessel. He must know where the ship will sail, what kind of cargo it will carry, and how fast it will have to travel. The architect also must be aware of government safety regulations. In addition, he must adjust his designs to allow for the ever-increasing use of automation on ships.

The shipyard carefully follows the architect's designs in building a ship. Traditionally, construction begins with the laying of the keel. Workers then build the ribs that support the hull and give it shape. Next, they weld the metal plates that form the middle section of the hull. As the middle section is built, the various compartments, the boilers, and the necessary machinery are added. Finally, the bow and stern are built, completing the hull.

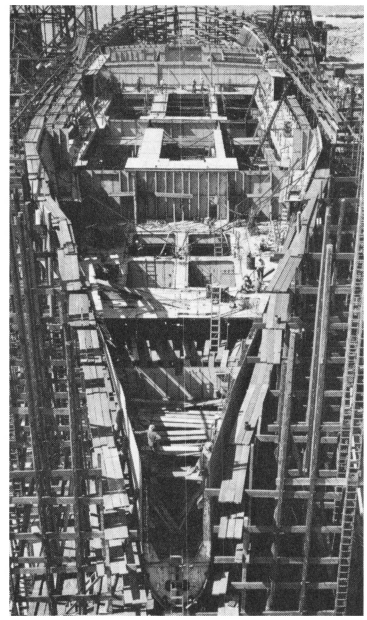
Modern shipyards no longer construct ships in this piece-by-piece manner. Instead, they first build enormous prefabricated sections of the ship in subassembly shops. Many of these sections have some wiring and piping built into them. Giant cranes then carry these huge sections to a framework called a *shipway*, where they are welded together. There is no laying of the keel. As the double-bottom sections of the hull are welded together, the keel is laid automatically. The entire hull may consist of as few as 20 prefabricated units. After the hull is completed, parts of the superstructure are added. The ship is then ready to be launched.

HOW A SHIP IS BUILT

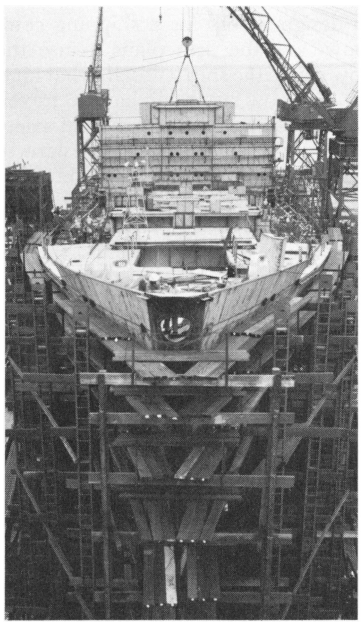
Modern shipyards construct ships of prefabricated units. Here, the first section of the double bottom of a cargo ship has been set in place. There is no laying of the keel because it is part of the bottom.



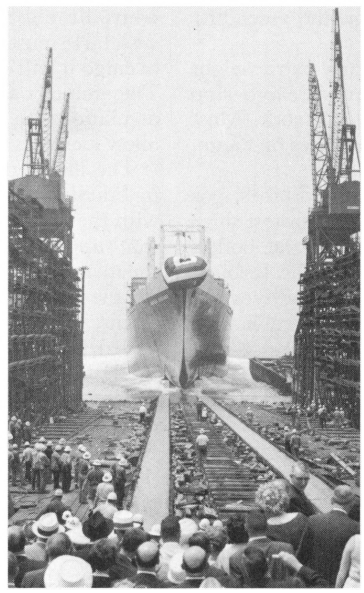
This picture, taken from the bow of the ship, shows that the bottom has been completed and some ribs installed in front of a bulkhead. The area in which the men are working will be the engine room.



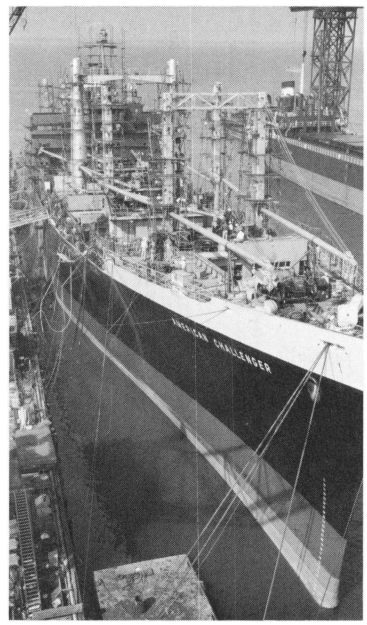
About half the hull has been completed. The middle section is finished first so the engines can be installed. The large openings are hatches. The platforms around the hull are used by welders and painters.



The hull has been completed, and the bridge and other parts of the superstructure are now lowered into place. By this time, most of the machinery and much of the wiring and piping have been installed.



The ship, about 90 per cent completed, is being launched. The ship's sponsor has just named the vessel and broken a bottle of champagne across its bow. At that moment, the ship began to slide into the water.



Newport News Shipbuilding and Dry Dock Co.

The ship is finished at an outfitting pier, where workers complete the superstructure and add the interior furnishings. The ship is then taken to sea to test its machinery, speed, and maneuverability.

Launching and Outfitting a Ship. Shipbuilders launch a ship after it is about 70 to 90 per cent completed. The ship is slid down a runway of heavily greased timbers into the water. Most ships are launched stern first. A ship launched bow first would plow down into the mud. Ships built along rivers too narrow for stern launching are launched sideways. Some yards build their ships in dry docks below the water level. After the hull and superstructure have been completed, workers open the valves and flood the dock. The ship then gently floats off the blocks that support the bottom of the hull. After the water inside the dock reaches the level of the water outside it, the dock gate is opened and the ship is launched.

Just before a ship is launched, it is christened. The shipping company selects a woman as the ship's sponsor. She names the vessel and breaks a bottle of champagne across its bow. At that instant, the ship begins to slide into the water.

After a ship has been launched, a tug pulls it to an *outfitting pier*. There, workers complete the superstructure and add the interior furnishings. The ship then makes its *builder's trials* with observers aboard from the company that ordered the ship. They make sure that all the equipment is in good working order and that the ship performs maneuvering, speed, and other tests according to the specifications. If the ship returns from the trials with a broom tied to the mainmast, it has made a "clean sweep" of its tests and the shipping company has accepted delivery of the vessel.

SHIP / *Merchant Fleets of the World*

Altogether, the countries of the world have about 61,000 merchant ships. The vessels total about 311 million gross tons. Each year, about 30 million gross tons of new shipping are built. Japan is by far the leading shipbuilding country in the world. It produces about half the total gross tonnage of ships launched annually.

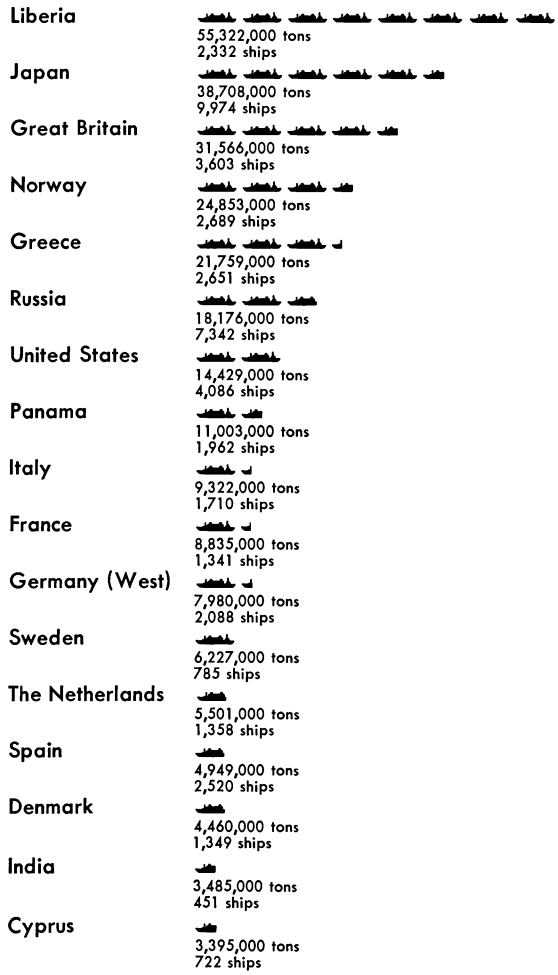
The United States Merchant Marine consists of about 4,000 ships, including Great Lakes and other inland-water vessels. All these vessels are registered in the United States and fly the American flag. The size of the U.S. merchant fleet has been declining steadily, and the fleets of other maritime nations have been growing. In addition, many U.S. merchant ships are inactive or overage. The United States has fewer than 300 American-flag ships engaged in its foreign trade. The United States is the chief trading country in the world. It accounts for almost a third of the total world trade, most of which is carried in ships. Yet American-flag ships carry only about 6 per cent of the country's foreign trade.

The federal government requires that all merchant ships registered under the United States flag must be American-built and operated by American crews. But building and operating ships manned by American crews costs about 50 per cent more in the United States than in other countries. American-flag ships can compete against foreign vessels only with the help of *subsidies* (grants of money) from the government. The government grants subsidies because it believes that a merchant fleet is vital to the country's foreign trade and national defense. Without a merchant marine, the nation would be completely dependent on foreign lines —which owe no allegiance to the United States—to carry American trade. In wartime, U.S. cargo ships are needed to carry supplies, and shipyards must be in operation to build warships.

The Maritime Administration has control over subsidized shipping lines. The administration requires that such lines provide regular service on trade routes it selects as essential to U.S. foreign trade and defense. The administration also requires that subsidized lines return to the government half of all their profits over a

LEADING MERCHANT FLEETS OF THE WORLD

Gross tons of ships registered in each country in 1974*



*Includes ships of 100 gross tons or more.
Source: *Lloyd's Register of Shipping, Statistical Tables, 1974.*

stated amount. Subsidized operators must also replace ships that the administration considers too old for service.

Many American ship operators prefer not to accept government subsidies. Instead, they buy their ships from foreign shipyards at about 50 per cent less than American-built vessels and register them under the flag of a foreign nation. As a result, U.S. shipyards turn out only about 3 per cent of the total gross tonnage of new ships built throughout the world each year. By registering their ships under a foreign flag, ship operators can operate them with lower-paid foreign crews, avoid strict U.S. safety regulations, and pay lower taxes. A number of nations allow their flag to be used in this way as a *flag of convenience* for a registration fee.

In 1970, the U.S. Congress approved a program proposed by President Richard M. Nixon to rebuild the country's merchant marine. The multibillion-dollar program calls for 30 modern merchant ships to be built each year for 10 years.

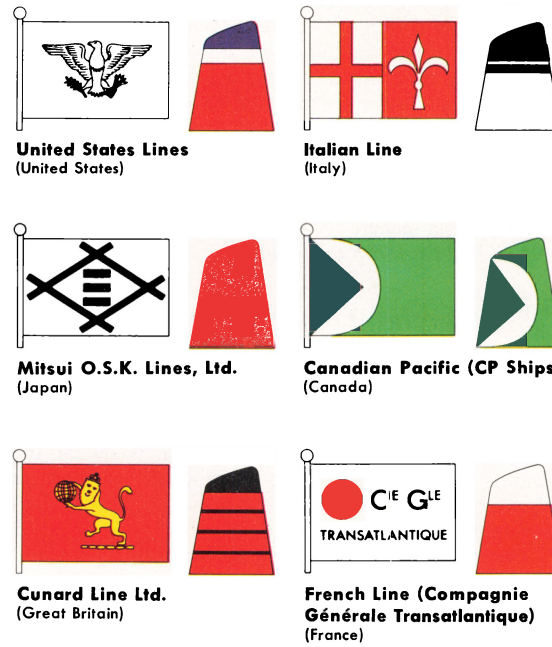
Merchant Fleets of Other Countries. Many countries have a long tradition as seafaring nations. They include Denmark, France, Great Britain, Italy, The Netherlands, Norway, and Sweden. All these countries have been increasing the size of their merchant marines. A number of other nations—especially Japan and Russia—have also been enlarging their fleets.

Liberia has the world's largest merchant marine. This country has more than 55 million gross tons of ships registered under its flag, which it allows to be used as a flag of convenience. Liberians themselves own only a few ships. Companies of other countries own almost all Liberian-flag vessels. These companies register their ships in Liberia rather than in their own countries because Liberia has lower taxes, allows shipowners to pay lower wages, and does not require many costly safety features. Liberia earns about $3 million yearly from ship registration fees. Other countries that have a flag of convenience include Haiti, Honduras, Lebanon, and Panama.

FLAGS AND FUNNELS OF SHIPPING COMPANIES

Shipping companies fly a private flag, called a *house flag*, to identify the ships they own or operate. On many merchant ships, the colors and emblem of the house flag also appear on the funnel.

WORLD BOOK illustration by Mas Nakagawa



By the end of World War II, Japan's merchant marine had fallen to about 1¼ million gross tons. Today, the country has the world's second largest fleet—nearly 39 million gross tons of ships. Japan has also become the world's leading shipbuilding nation. Its shipyards launch about 15 million gross tons of ships a year—about half the world's total annual production. Over 60 per cent of the shipping built by the Japanese is sold to foreign lines.

SHIP / *Careers in the U.S. Merchant Marine*

Although the size of the U.S. merchant fleet has been declining steadily, about 27,000 officers and seamen still work aboard American merchant ships. In addition to deck officers, engineers, and seamen, all ships employ radio operators, stewards, cooks, and mess personnel. Passenger and cruise ships also hire large staffs of service workers.

Finding Employment. Most shipping companies hire personnel through union *hiring halls* in major U.S. ports. Almost all officers and crew members who find jobs aboard ships belong to unions. For example, deck officers belong to the International Organization of Masters, Mates, and Pilots. Engineers are members of the National Marine Engineers' Beneficial Association. Radio operators belong to the American Radio Association. Federal law requires that unions allow nonmembers to find jobs through the hiring halls. But nonmembers usually can find work only if more jobs are available than union members can fill.

Persons going to sea for the first time must get a *merchant mariner's document* from the U.S. Coast Guard. This certificate, usually called *seaman's papers*, gives them the official position of seaman. Before inexperienced persons can get these papers, they must prove to the Coast Guard that they are employed on a ship.

Young persons can work their way up through the ranks from seaman to officer. To do so, they must spend at least three years at sea, working either on the deck or in the engine room. They must then pass a licensed officer's examination given by the Coast Guard. Most persons, however, earn their officer's license by studying at a maritime academy.

Maritime Academies are operated by the federal government and a few states. The federal institution

is the U.S. Merchant Marine Academy at Kings Point, N.Y. The academy has equal status with the academies of the U.S. armed forces. To learn about the school's entrance requirements and course of study, see UNITED STATES MERCHANT MARINE ACADEMY.

Five states have maritime academies. These academies generally require three or four years of study to earn an officer's license. The state schools are the California Maritime Academy, Vallejo, Calif.; the Maine Maritime Academy, Castine, Me.; the Massachusetts Maritime Academy, Buzzards Bay, Mass.; the New York State University Maritime College at Fort Schuyler, New York, N.Y.; and the Texas Maritime Academy, Galveston, Tex.

LIONEL CASSON

SHIP / *Study Aids*

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Questions

What is a *flag of convenience?*

What was the first commercially successful steamboat? Who built it?

Why has the transatlantic passenger liner service declined sharply since the late 1940's?

What does it mean if a newly built ship returns from its builder's trials with a broom tied to the mainmast?

Who was Donald McKay? Isambard Kingdom Brunel? John Fitch?

What is the difference between a tramp ship and a cargo liner?

Why did the invention and development of the steam engine revolutionize water transportation?

What are some safety standards that ships must follow?

How does a container ship differ from a traditional general cargo ship?

What is a *merchant marine?*

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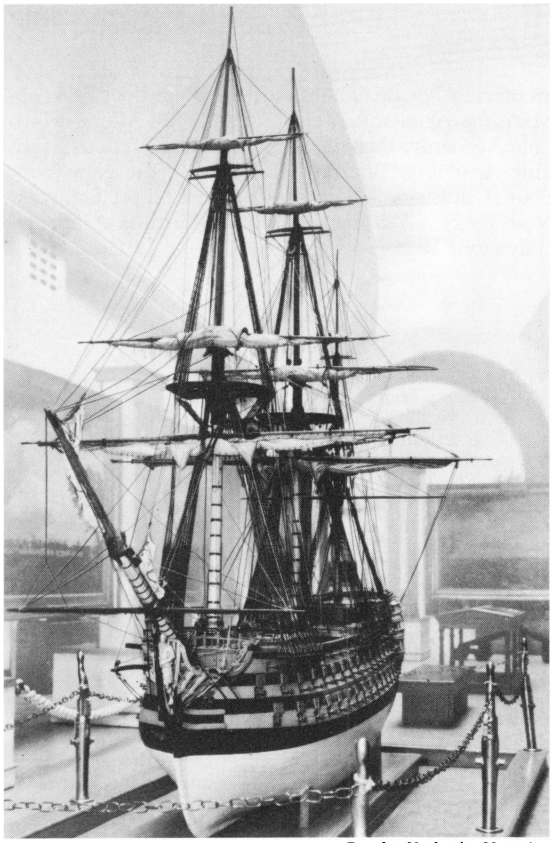


Popular Mechanics Magazine

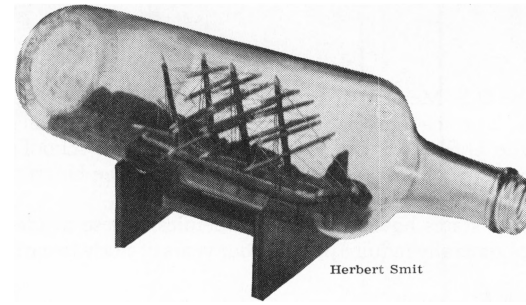
A Prized Model Ship in the French Naval Museum is a 124-cannon man-of-war, built more than 200 years ago for the nautical instruction of Louis XV. The fully rigged ship is 1/36 actual size.

SHIP, MODEL, is a small copy of a full-sized ship or boat. Making model ships can be a fascinating hobby for both children and adults. Some hobbyists carve models by hand. Others make boats and ships from accurate kits sold by hobby shops. These models are made of plastic or wood. Some sailboat modelmakers belong to clubs that sponsor races.

Sailors on long voyages often made model ships in narrow-necked bottles. These make interesting collectors' items. The spars and rigging were made in fine detail. When the model was finished, the sailor inserted it in the bottle with the spars and rigging lying down. A pull of one thread drew the rigging upright.

ITC Modelcraft

A Model Ship Takes Form as a young craftsman builds an 18-inch (46-centimeter) replica of a 110-foot (34-meter) subchaser used by the U.S. Navy in World War I.



Herbert Smit

A Model Ship in a Bottle is first completely constructed outside the bottle. The builder then folds the masts down, slides the ship down the bottle's neck, and pulls up the masts.

Model ships also play an important part in the shipbuilding industry. Old-time shipbuilders carved models to guide the workmen. They used no blueprints or plans. Today, preliminary models help designers select the final form of a ship's hull before they draw the design. These models are tested in a towing tank to provide information on how the hull of a full-sized ship will act at sea and at various speeds. All important commercial and naval ship designers tank-test preliminary models before finally deciding on a design.

Museums display models of vessels of former times. Many steamship companies use large elaborate models of their ships to decorate their offices and travel bureaus. These models sometimes cost thousands of dollars. The New York Yacht Club, in New York City, owns one of the largest collections of model sailing and power yachts. WILLIAM W. ROBINSON

See also MAINE (Places to Visit [Penobscot Marine Museum]); FROUDE (William).

SHIP OF THE DESERT. See CAMEL (Legs and Feet).

SHIPPENSBURG STATE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SHIPPING. See SHIP.

SHIPROCK. See NEW MEXICO (Land Regions).

SHIP'S BELL. See SHIP (Nautical Terms).

SHIP'S LOG. See LOGBOOK.

SHIP'S STORE. See POST EXCHANGE.

SHIPWORM is one of a group of sea animals that bores in wood. Certain kinds of shipworms can make tunnels more than 3 feet (91 centimeters) long. They bore downward and inward with two clamlike shells. They line the tunnel with a white shelly material.

Shipworms are *bivalves* (animals with a two-pieced shell). Young shipworms look like tiny clams and can swim about freely. But they soon attach themselves to wood and begin to bore a hole in it. Shipworms have been known to bore $\frac{3}{4}$ inch (19 millimeters) in a day and to honeycomb lumber within six months.

Scientific Classification. Shipworms are in the shipworm family, *Teredinidae*. They make up the genera *Bankia* and *Teredo*. The common teredo of the United States, Europe, and Africa is genus *Teredo*, species *T. navalis*. R. TUCKER ABBOTT

SHIPWRECK is the destruction or loss of a ship. Shipwrecks have various causes. A ship may be destroyed

MAJOR SHIPWRECKS

Year	Ship	Dead	Disaster
1833	*Lady of the Lake*	215	struck iceberg in N. Atlantic
1852	*Birkenhead*	420	wrecked off South Africa
1853	*Annie Jane*	348	wrecked off Scotland
1854	*City of Glasgow*	399	vanished out of Liverpool
1857	*Central America*	422	sank on Cuba-New York run
1858	*Austria*	509	burned in N. Atlantic
1859	*Pomona*	388	wrecked off Ireland
1865	*Sultana*	1,653	exploded on Mississippi R.
1867	58 vessels	1,000	hurricane in West Indies
1873	*Atlantic*	500	wrecked off Nova Scotia
1878	*Princess Alice*	640	collided in Thames River
1891	*Utopia*	533	collided off Gibraltar
1895	*Reina Regenta*	402	foundered near Gibraltar
1898	*City of Portland*	114	wrecked off Cape Cod
	La Bourgogne and *Cromartyshire*	561	collided off Nova Scotia
1904	*General Slocum*	1,030	burned in East River, N.Y.
	Norge	651	wrecked off Scotland
1912	*Titanic*	1,500	struck iceberg in N. Atlantic
1914	*Empress of Ireland*	1,029	collided in St. Lawrence R.
1915	*Eastland*	812	overturned in Chicago R.
1917	*Mont Blanc*	1,635	collided in Halifax harbor
1928	*Vestris*	111	sank in storm off Virginia
1931	*St. Philibert*	368	overturned off France
1934	*Morro Castle*	134	burned off New Jersey
1942	*Curacao*	335	collided off England
1948	*Kiangya*	1,100	exploded in China Sea
	Taiping	600	collided off China
1949	*Noronic*	136	burned at Toronto dock
1952	*Hobson*	176	collided in Atlantic
1953	*Chang Tyong-Ho*	249	sank off Pusan, South Korea
	Princess Victoria	134	sank off Northern Ireland
1954	*Toya Maru*	794	sank in Tsugaru St., Japan
1956	*Andrea Doria*	51	collided off Nantucket I.
1958	*Uskudar*	361	capsized off Izmit, Turkey
1961	*Dara*	212	burned in Persian Gulf
	Save	259	sank off Mozambique
1963	U.S.S. *Thresher*	129	sank in N. Atlantic
1965	*Yarmouth Castle*	87	burned off Nassau
1966	*Heraklion*	264	sank in Aegean Sea
1970	*Christena*	125	sank off St. Christopher
1974	Russian destroyer	275	exploded in Black Sea

Sources: Lloyd's Register of Shipping; U.S. Coast Guard

by fire or it may sink after colliding with another vessel. The causes of some shipwrecks are unknown.

Safety devices used to help prevent shipwrecks include *electronic depth finders* to help keep ships from going aground and *radar* to make navigation safer at night (see FATHOMETER; RADAR [Ships]). International agreements, including the International Conventions for the Safety of Life at Sea (SOLAS), set up safety standards for ships. The International Ice Patrol protects ships by furnishing information on drifting ice and icebergs.

See also ICE PATROL, INTERNATIONAL; NAVIGATION; SALVAGE; SHIP (Safety at Sea); TITANIC.

SHIRAZ, *shee RAHZ* (pop. 269,865), one of Iran's largest cities, is the capital of the southwestern province of Fars (see IRAN [map]). The city's products include Persian rugs, textiles, and silver work. Historians think Shiraz was founded in the A.D. 600's. The city has many mosques. RICHARD NELSON FRYE

SHIRE, *shyr*, was an early geographical division of England. Shires had about the same boundaries as counties. They were first formed in the Anglo-Saxon states, and were made up of smaller districts called *hundreds*. See also ENGLAND (The Anglo-Saxon Period).

SHIRE RIVER. See LAKE NYASA.

SHIRLEY, WILLIAM (1694-1771), served as colonial governor of Massachusetts from 1741 to 1756. For a short time, he commanded all British forces in North America. He was responsible for the important capture of the French stronghold of Louisbourg in 1745, during the French and Indian Wars. When England paid Massachusetts for its part in the war, Shirley redeemed the colony's paper money and built a sound currency. Shirley was born in Sussex, England. BRADFORD SMITH

SHIVA. See JUDAISM (Special Occasions).

SHIVA is one of the two leading gods of Hinduism. Vishnu is the other. Shiva, a god of great power, is beyond distinctions of good and evil. Hindus call him *the Destroyer* because he periodically destroys the world in order to re-create it again.

Shiva has a terrifying appearance. Many Hindus believe he haunts graveyards and lives with demons and other supernatural beings. But Shiva's followers consider him a merciful god, despite his fearsome characteristics. In Hindu philosophy, Shiva avoids taking an active part in human affairs. Hindu works of art show him meditating alone on a mountain. Many Hindus worship Shiva as the physical form of Brahman, the most abstract and absolute form of God. Shiva's wife, who has several names, plays an important part in human affairs. CHARLES S. J. WHITE

See also BRAHMAN; HINDUISM (Divinities); SCULPTURE (Oriental [India, with picture]).

SHOAT. See HOG (Hog Terms).

SHOCK. A blow, a wound, a burn, or some other accident can cause a severe shock to the entire body. Shock stuns and weakens the vital processes of the body. Control of blood-flow is upset. The patient's skin becomes pale, and he perspires and feels faint. The blood pressure decreases, and the pulse grows weak.

About an hour later, *secondary shock* occurs. The patient loses color and grows weaker. His blood pressure falls, and his pulse becomes feeble. His breathing becomes shallow and weak, his perspiration turns cold, and blood vessels near the surface of the skin collapse. Some accident victims seem unaware of their serious condition, and want to go on their way as if nothing had happened. But if the condition is not corrected, the victim may lose consciousness or even die.

Secondary shock is common in severe wounds and operations. It is best treated by placing the patient in the *shock position*, with his feet higher than his head. This helps blood reach his vital organs. Further treatment with complete rest, warmth, stimulating drugs, and blood plasma should follow. JOHN B. MIALE

SHOCK, ELECTRIC. See ELECTRICITY (How to Use Electricity Safely); SHOCK TREATMENT.

SHOCK ABSORBER is a device that reduces shock or concussion. It is used on automobiles, airplane landing gears, and doors. Most shock absorbers consist of a piston inside a cylinder that contains air or oil. Automobile shock absorbers consist of a piston inside an oil-filled cylinder. When the car wheel hits a bump, the piston pushes upward. But the oil resists the piston. This resistance to the motion of the piston offsets the force of the bump and absorbs the shock. See also AUTOMOBILE (The Suspension System; diagram); SPRING (metal); TORSION BAR SUSPENSION. WILLARD L. ROGERS

SHOCK TREATMENT

SHOCK TREATMENT is a term applied to several different treatments for patients with serious mental illnesses, usually the psychoses (see PSYCHOSIS). These treatments are alike in that they make the patient temporarily unconscious, or put him in *shock*. Doctors use shock treatment alone or together with psychotherapy (see PSYCHOTHERAPY).

The most widely used forms of shock treatment are *insulin* treatment and *convulsive* treatment. Both were first used equally for treating psychotic patients in the 1930's. By 1950, however, doctors used convulsive treatment far more frequently.

When doctors first used insulin to produce shock, they hoped it would effectively cure schizophrenia. But the treatment helped only in some cases, and often produced only temporary improvement. For these reasons, and because it is difficult to use insulin treatment safely, many doctors gave up using it. See INSULIN.

Convulsive treatment was introduced a few years after insulin treatment. The treatment produces convulsions in a patient. The simplest and most usual method for convulsive treatment consists of passing an electric current through a patient's brain for a fraction of a second. This form of treatment is often called *electroshock*.

The technique used in electroshock treatment is quite simple, but it must be adjusted to the individual case. The number of treatments varies, but it is usually three times a week. Doctors determine the amount and the duration of the electric shock by estimating the voltage and amperage of the current. A preshock medication or a complete anesthetic is often given to reduce the anxiety of the patient. In the standard electric shock, the patient does not feel the electric current.

Doctors use electroshock to some extent to treat schizophrenia. But its most important use is in treating patients with manic-depressive psychosis. Electroshock treatment is often successful in restoring depressed patients to a normal or healthy mental state. The way it does this is not known. Doctors also use drugs, such as Metrazol, to induce shock. CHARLES BRENNER

See also MENTAL ILLNESS (Electric Shock Treatment).

SHOCK WAVE. See AERODYNAMICS (Shock Waves).

SHOCKLEY, WILLIAM (1910-), an American physicist, was one of the discoverers of the transistor. With John Bardeen and Walter Brattain, he received the 1956 Nobel prize in physics for discovering the principles of electrical conduction in solids that make the transistor possible (see TRANSISTOR).

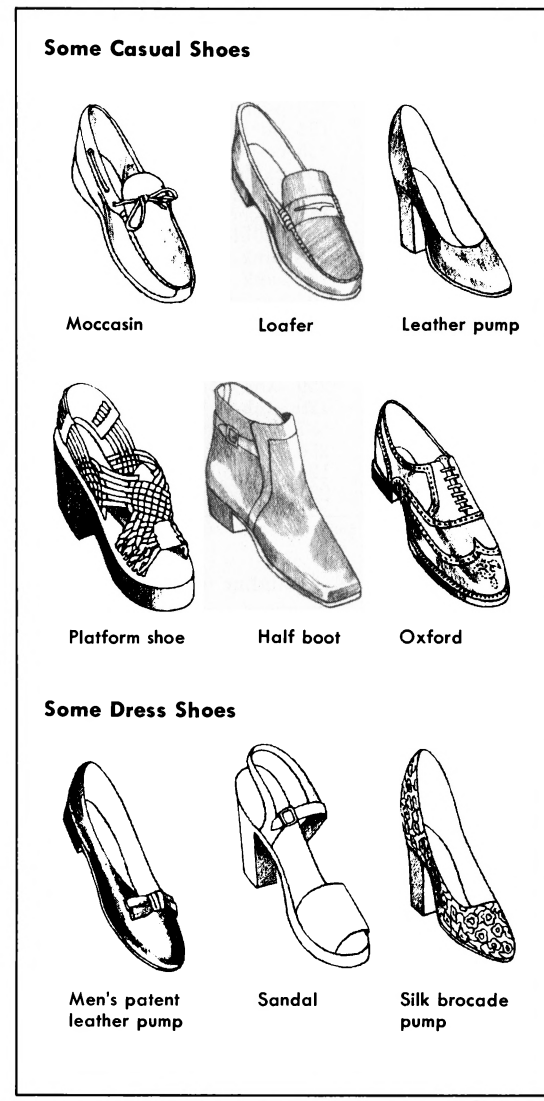
Shockley was born in London. At the time the transistor was discovered in 1947, he was a physicist at the Bell Telephone Laboratories. He became a professor at Stanford University in 1963.

In the early 1970's, Shockley's views on race and intelligence sparked much controversy. He claimed that heredity, rather than environment, was mainly responsible for whites' generally scoring higher than blacks on intelligence tests. Most geneticists and psychologists disagreed with this theory. See INTELLIGENCE (Controversy over Intelligence). CHALMERS W. SHERWIN

SHODDY is a woolen cloth made of yarn that has been used before. The name *shoddy* has come to mean any cloth of poor quality.

SHOE is an outer covering for the foot. Shoes have a sole, and most shoes also have a heel. The upper part of most shoes extends no higher than the ankle. Boots are footwear that reach beyond the ankle. People wear shoes to protect their feet from cold weather, sharp objects, and uncomfortable surfaces.

Shoes are also an important part of people's clothing. As a result, fashion often determines the style of shoes that individuals wear. The desire of men and women to be fashionable has led to many unusual shoe styles. For example, many European men of the 1300's wore shoes called *crackowes*, which had an extremely long toe. Some crackowes had a toe so long that it had to be fastened to the knee with a chain to prevent the wearer from tripping. Some European women of the 1600's wore shoes with soles so thick that walking was impossible without support. Shoes once worn in the Orient



WORLD BOOK illustrations by David Cunningham

Casual Shoes and Dress Shoes are manufactured in a variety of styles. Most of these kinds of footwear are made of leather, but other materials may also be used.

were connected to a stilt as high as 6 inches (15 centimeters).

Most shoes are made of leather. But shoe companies also use many other materials, including canvas, velvet, and such synthetic substances as plastics. Shoe materials and styles vary somewhat from one country or region to another, depending on climate, custom, or other differences. For example, farmers and fishermen in The Netherlands often wear heavy wooden shoes that protect their feet from the damp ground. Many Japanese wear shoes outside their home but prefer soft slippers at home. People in some regions often wear foot coverings other than shoes. They may wear sandals during the hot summer and switch to warm boots for the cold winter.

Kinds of Shoes. There are four main kinds of shoes, depending on their use: (1) casual and dress shoes, (2) sport shoes, (3) work shoes, and (4) corrective shoes.

Casual Shoes and Dress Shoes are made for almost all everyday occasions. Most casual shoes are based on such low-heeled styles as the loafer, moccasin, oxford, and pump. Oxfords feature a lacing up the top and over a tongue. Loafers, moccasins, and pumps are *slip-on* shoes that have no lace or tongue.

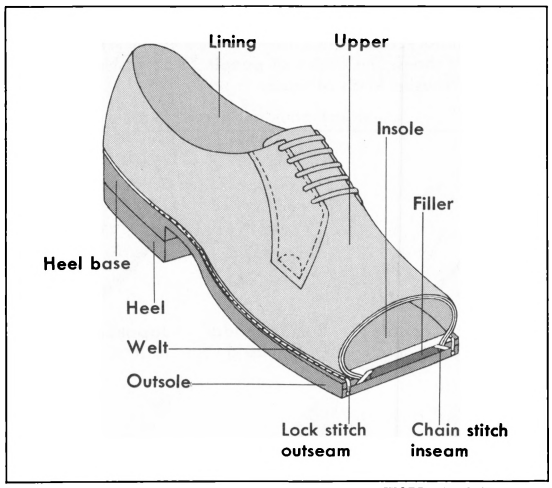
Most dress shoes, or *evening shoes*, for women are based on the pump or sandal style and have high or medium heels. Materials used for these shoes include brocade, satin, silk, tapestry, and velvet. Most men's dress shoes are pumps and are made of leather or *patent leather* (leather with a glossy finish).

Sport Shoes have different features for various sports. For example, basketball shoes and tennis shoes have rubber soles that keep the player from slipping. These soles also prevent the shoes from damaging the playing surface. Baseball shoes have metal or synthetic-rubber spikes that enable the wearer to start and stop quickly. Football shoes have synthetic-rubber cleats for the same purpose.

Work Shoes are worn for safety and comfort in many kinds of jobs. Most types of work shoes are sturdy and long wearing and are made of leather. Workers in some factories wear shoes equipped with a steel section inside the toe for protection against injury. People in many trades require shoes especially designed to prevent slipping. Most mail carriers, nurses, waitresses, and others who must stand or walk for long periods wear shoes that have a cushioned sole.

Corrective Shoes are designed to provide relief from such foot conditions as bunions and corns (see BUNION; CORN). They also are used for *hammertoes* (toes bent in the form of a claw) and other disorders. Some corrective shoes are ready-made products that have built-in corrections for the most common foot problems. For example, one style features a special heel that supports the *arch*, the curved part of the sole of the foot. Other corrective shoes are specially made for one person, some according to a physician's prescription. A person can also have special shoes made to fit the exact shape of the feet—including any corns or other bulges. Such shoes allow space for the swellings and so reduce the pressure against these areas.

Shoes called *negative heel shoes* are intended to prevent, rather than correct, problems that may be caused by shoes. The heels of negative heel shoes, unlike those of most shoes, are lower than the toes. Designers of negative heel shoes declare that the low heels help a person stand and walk more upright than is possible with regular shoes. But they warn that negative heel shoes may be harmful for persons who have flatfeet or problems with an Achilles' tendon (see ACHILLES' TENDON; FLATFOOT).



WORLD BOOK diagram

The Parts of a Shoe are put together by various machines operated by workers at a shoe factory. The sections of the upper part of the shoe are sewed together and then fastened to the sole.

The Shoe Industry of the United States produces about 490 million pairs of shoes annually, of which about $3\frac{1}{2}$ million pairs are exported. Americans buy about 300 million pairs of shoes yearly that have been imported from Italy, Japan, Spain, and other countries. The manufacture of a pair of shoes requires dozens of operations and many workers. In general, shoes made outside the United States cost less than American-made shoes because of lower labor costs in many other countries.

Most shoe designers work for manufacturers of footwear. A shoe designer makes sketches of various ideas and decides what colors and materials will be used. The manufacturer produces samples of the shoes, and sales representatives show the samples to buyers from shoe stores and department stores. The buyers then order the shoes from the manufacturer.

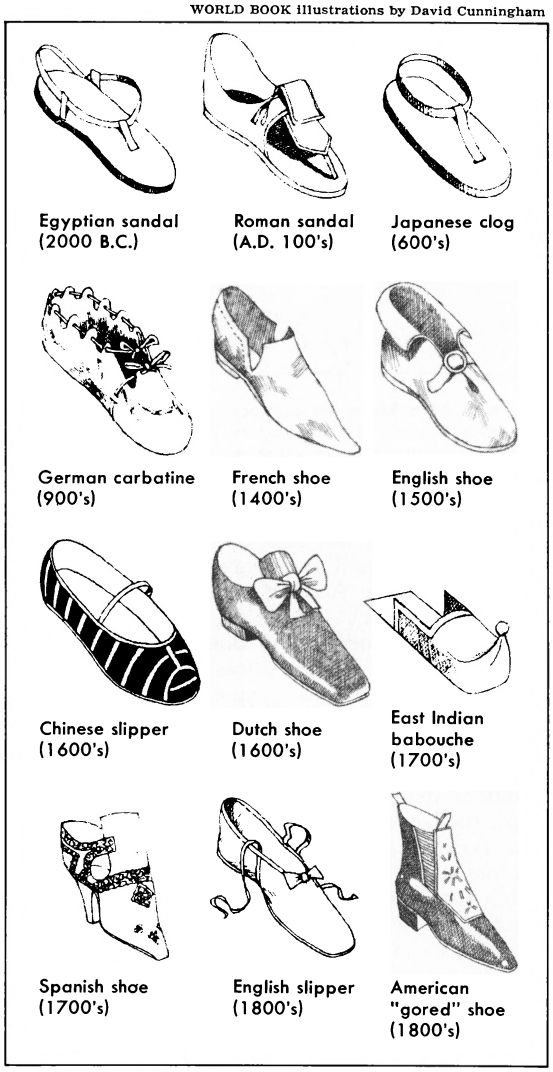
At a shoe factory, workers make a pattern of each shoe style. Using the pattern, other workers cut sections that will form the *upper* (upper part) of the shoe. The sections of the upper are then stitched together on a machine. Another type of machine prepares the sole. A *shoe-lasting* machine molds the upper on a *last*, a wooden block shaped like a foot. On the last, the upper is fastened to the sole by gluing, stitching, or some other method. Finally, the heel and such decorations as a bow or buttons are added.

Shoes and Health. Shoes that have been poorly fitted can cause such problems as backaches, sore muscles, fatigue, and poor posture. Shoes that are too tight may result in bunions, corns, hammertoes, and ingrown toenails. Such problems can be avoided by taking special care when buying shoes, especially children's shoes. Most children outgrow shoes within a few months.

Some Shoes of the Past

Throughout history, fashion has often determined the style of men's and women's shoes. The desire of people to be fashionable has led to many unusual kinds of shoes.

WORLD BOOK illustrations by David Cunningham



Shoes should have a space of $\frac{1}{2}$ to $\frac{3}{4}$ inch (13 to 19 millimeters) between the tip of the big toe and the shoe. Most people have one foot that is larger than the other, and so both feet should be fitted. A person should walk around in the store while trying on new shoes to ensure a comfortable fit.

Some people wear certain fashionable shoes even though these shoes are uncomfortable and can hurt the feet. For example, heels higher than 2 inches (5 centimeters) cramp the toes by pushing the feet forward. Pointed shoes also crowd the toes. Shoes with hard, high soles can prevent flexible movement of the feet. Hot feet can result from shoes that do not *breathe* (allow foot moisture to escape). Most shoes made of a synthetic material do not breathe so well as leather ones.

History. No one knows when man first began to wear shoes. The first foot coverings worn in cold regions were probably baglike wrappings made of animal fur. The first known footwear used in warm surroundings consisted of sandals made of plant fibers or leather. The ancient Egyptians wore such sandals as early as 3700 B.C., and the ancient Greeks and Romans also wore sandals. Those three peoples also wore soft leather shoes occasionally. In China, people wore wooden-soled shoes and cloth shoes thousands of years ago.

Throughout history, shoes have been worn not only for protection but also for decoration and to indicate social status. Various shoe styles have gone in and out of fashion, just as they do today. For example, people in Western Europe wore shoes with long, pointed toes for several centuries until the A.D. 1500's. The fashion in women's shoes changed to rounded toes during the 1500's, low heels by the late 1500's, and high heels in the 1600's.

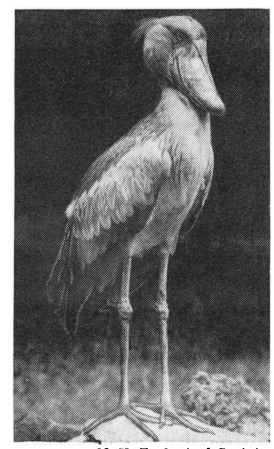
The Indians of North America made moccasins of animal skins before European settlers first arrived. The Europeans who settled in the New World wore sturdy leather shoes most of the time, but some colonists also wore moccasins.

Until the mid-1800's, despite the many changes in shoe styles, shoemaking itself involved chiefly the use of simple hand tools. Most people wore homemade shoes or bought shoes from a shoemaker who lived nearby or traveled from house to house. Improved sewing machines were developed in the mid-1800's, and shoemaking became a factory operation. These machines had special devices to stitch shoe parts that previously had required nailing or stitching by hand.

In 1882, Jan Ernst Matzeliger, a worker in a Massachusetts shoe factory, invented the shoe-lasting machine. This and other new shoemaking machines led to the mass production of shoes by 1900. The mass production of footwear brought a great reduction in the price of these products. MARION LILLARD

See also LEATHER; MATZELIGER, JAN ERNST; MOCCASIN; WOODEN SHOE.

SHOEBILL is a large bird related to the stork. It is sometimes called the *whale-headed stork*. The shoebill was once thought to be the rarest of birds. But many live in Africa on marshes from the Upper Nile to Uganda and Congo. The bird stands about 4 feet (1.2 meters) high. It is ashy-gray and is named for its enormous bill. When disturbed, it snaps its bill open and shut rapidly, making a loud rattling sound.



N. Y. Zoological Society

The African Shoebill

The shoebill has long legs. It wades in shallow water, where it feeds on fish. It flies with its neck in the shape of an *S*, its long legs trailing behind. Shoebills live in pairs and sometimes prey on small animals. They do not nest in trees. They make a large platform of reeds lined with grass for nesting. The

female bird lays one or two rough-shelled white eggs.

Scientific Classification. The shoebill belongs to the shoebill family, *Balaenicipitidae*. It is genus *Balaeniceps*, species *B. rex*. RODOLPHE MEYER DE SCHAUENSEE

SHOEMAKER, WILLIE (1931-), an American jockey, became horse racing's all-time leading money-winner and won more races than any other jockey. By 1976, he had ridden nearly 6,900 winners and had won purses totaling over $55 million. In 1956, he became the first jockey to win more than $2 million in purses in one year. In the 1957 Kentucky Derby, Shoemaker led throughout, but misjudged the finish line and lost. Born William Lee Shoemaker in El Paso, Tex., he became a jockey in 1949. RICHARD G. HACKENBERG

SHOEPACK. See PIONEER LIFE IN AMERICA (Clothing).

SHOGUN, *SHOH GOON*, was the title of the greatest of the Japanese feudal lords. The term *shogun* means *great general* in Japanese, and is an abbreviation of a title meaning *Barbarian-Subduing Generalissimo*. This official had originally received emergency military powers from the Japanese emperor to fight against the Ainu tribe in the A.D. 800's. After 1192 the power of the imperial court decreased, and the shogun also assumed civil power. In theory, the emperor appointed each new shogun, but the shogun was the real ruler of Japan. The Minamoto, the Ashikaga, and the Tokugawa families carried the shogun title. The shogun's power reached its peak under the Tokugawa family, from about 1600 to 1867. In 1867, the shogun resigned and returned his powers to the emperor. MARIUS B. JANSEN

See also JAPAN (The Shoguns); SAMURAI.

SHOLES, *shohlz*, **CHRISTOPHER LATHAM** (1819-1890), an American inventor and journalist, helped develop the first practical typewriter. Sholes, Carlos Glidden, and Samuel W. Soulé designed the typewriter in 1867 and patented it in 1868. Glidden and Soulé sold their interests to Sholes and his new partner, James Densmore. They began to manufacture the machine but were unable to make and sell it. In 1873 they gave E. Remington and Sons a contract to make it. Sholes later sold most of his interests in the typewriter.

Sholes was born near Danville, Pa. He was a successful Wisconsin newspaper editor and served in the Wisconsin state legislature. Sholes and Soulé invented a page-numbering machine in 1866. MONTE A. CALVERT

SHOLOKHOV, MIKHAIL ALEXANDROVICH (1905-), is a Russian author. Sholokhov won fame for his novels and stories about the Don Cossacks, who lived near the Don River in Russia (see COSSACKS, DON). In 1965, he won the Nobel prize for literature.

Tass from Sovfoto

Mikhail A. Sholokhov

Sholokhov's best-known work is the four-volume historical novel *The Quiet Don* (1928-1940). This novel deals with the way the Russian Revolution and civil war from 1917 to the early 1920's caused conflicts among the Don Cossacks. Sholokhov also wrote *Virgin Soil Upturned* (1932, 1955-1960), a two-volume novel about the problems Don Cossack farmers faced when the government set up collective farms. His first works were two books of stories about the Don Cossacks, *Don Tales* (1925) and *The Azure Steppe* (1926). He was born in Veshenskaya, a Don Cossack village.

SHOLOM ALEICHEM, *SHOH luhm ah LAY hehm* (1859-1916), was the pen name of Solomon Rabinowitz, the most widely read of all Yiddish writers. He wrote humorous novels, short stories, and plays about Jewish life in western Russia and Jewish immigration to the United States. His technique of "laughter through tears" emphasized the dignity, generosity, and shrewd self-appraisal of his poverty-stricken characters. His writings have been translated into many languages. Major works include the novels *Tevye the Dairyman*, *Menakhem-Mendl*, and *Motl the Cantor's Son*, and the play *It's Hard to Be a Jew*. He was born near Kiev, Russia, and came to the United States in 1914. URIEL WEINREICH

SHOOTING. See ARCHERY; FIREARM; GUN; HUNTING.

SHOOTING STAR. See METEOR.

SHOOTING STAR. See COWSLIP.

SHOPPING. See CONSUMER PROTECTION; HOMEMAKING.

WORLD BOOK photo

The Mall of a Shopping Center is an open area surrounded by retail stores. In many centers, the mall and stores are under one roof. Fountains and trees add beauty to the mall.

SHOPPING CENTER is a group of retail stores and business and professional offices built and managed as a unit. In many centers, the businesses are grouped around an open pedestrian area called a *mall*. The mall may be enclosed so that the entire shopping area can be heated and air-conditioned. Such a mall allows people to shop in comfort in any kind of weather. In many large centers, the mall is designed as an attractive park. A large center includes many facilities of a small city, such as art galleries, banks, hotels, medical clinics, a post office, restaurants, sports facilities, and theaters. Some centers even include churches and apartment buildings. Such centers resemble a shopping *town* more than just a shopping center.

In most centers, the merchants pay rent to a single firm that owns the center. The owner, in turn, seeks to attract people to the center to create a busy market setting for the tenants. First, the owner chooses a site convenient to the public and builds attractive facilities with an ample parking area. The owner then leases space to a carefully balanced selection of competitive stores that will have maximum appeal to the public. After the center opens, the owner provides for cleaning, maintenance, security, and fire protection. The owner also assists the merchants in staffing and operating a merchants' association. This organization plans and publicizes sales and promotional events. For example, the merchants may sponsor fashion shows, concerts, and other events that take place in the mall.

Marketplaces that lease space to traders have existed in many parts of the world from ancient times. However, they are relatively new in industrial nations. The United States had only about 10 shopping centers before World War II (1939-1945). Large numbers of centers have been built since the late 1940's, especially in the United States. Most have been built in suburbs. Only a few are located in downtown areas, where it is difficult to acquire enough land. By the mid-1970's, the United States had about 17,000 centers, which accounted for more than a third of the nation's retail business. SPENCER H. MACCALLUM

SHORAN, an abbreviation for **SHO**rt **RA**nge **N**avigation, is the name of an electronic system used for short-range aerial navigation, aerial photography, and aerial surveying. An airplane using shoran sends out radio signals to two ground stations, which rebroadcast the signals to the airplane. Electronic instruments record the time interval between sending and receiving the signals. Shoran calculates the distance to the stations by means of these intervals. Shoran was developed during World War II by the U.S. Army Air Forces and private industry. See also LORAN; NAVIGATION. G. D. DUNLAP

SHORE PATROL is the police department of the United States Navy. It is made up of selected officers and enlisted men with ratings of petty officers. They patrol shore areas that are occupied or visited by members of the Navy. In some cases, the Shore Patrol has authority over all servicemen. Shore Patrol members receive special training. They can arrest Navy men and enforce discipline, but cannot punish anyone. An offender is turned over to his commanding officer for trial. See also MILITARY POLICE. JOHN W. WADE

SHORT, WALTER CAMPBELL. See WORLD WAR II (The Attack on Pearl Harbor).

SHORT BALLOT. See BALLOT.

SHORT CIRCUIT. See FUSE, ELECTRIC.

SHORT-HORNED GRASSHOPPER. See LOCUST.

SHORT STORY is a form of fiction writing. We often tell our friends stories about events in our daily lives. We may tell *jokes* to make our friends laugh, or use *anecdotes* to help explain what we mean. These forms are closely related to the short story. But the short story has three important elements that are lacking in the stories we tell. A short story is carefully created, it is compact, and it is unified. All the details in a short story have a purpose, and add to its effect.

The short story is also related to the novel. Both deal with events in the lives of real or imaginary persons, and with almost any subject. But a short story generally develops only a single incident or crisis in human relations. Its characters are usually described quickly, with little detail.

A short story can run from about 3,000 to about 10,000 words in length. Some magazines specialize in so-called *short-short* stories, only about 1,000 to 1,500 words long. Longer prose works are sometimes called *novelettes* or *short novels.*

Authors interested in selling their stories should consult literary market lists to find which magazines accept their kinds of stories. These lists also give information on how manuscripts should be prepared for publication, the length of articles publishers will consider, and addresses of magazine and other publishing offices.

In the United States, Washington Irving developed the setting, Nathaniel Hawthorne added characterization, and Edgar Allan Poe brought in plot and helped establish the short story as a form. Some of Poe's famous stories, such as "The Gold Bug" and "The Cask of Amontillado," helped make the short story popular. Guy de Maupassant in France aided its development. Another American author, O. Henry, developed the surprise ending, sometimes in the last sentence, or even the last word. Two Russian authors, Anton Chekhov and Ivan Turgenev, specialized in realistic stories centered on characters rather than events.

Many kinds of short stories have been created by short-story writers. Poe's mystery stories led the way for A. Conan Doyle's detective stories about Sherlock Holmes; and the adventure stories of Robert Louis Stevenson, Rudyard Kipling, Jack London, and Bret Harte. Joseph Conrad and Katherine Mansfield wrote character studies. P. G. Wodehouse and Dorothy Parker produced humorous short stories based on comic situations. Damon Runyon and Octavus Roy Cohen wrote stories in unusual local dialects. DONALD H. LUDGIN

See also FICTION; NOVEL; PARABLE; DETECTIVE STORY.

SHORT TON. See TON.

SHORT WAVE is a radio term for wave lengths that represent higher frequencies than those used for ordinary broadcast transmissions. The classification of the different frequency bands above 3,000 kilohertz (abbreviated kHz) is as follows:

Frequency in Kilohertz	Frequency Designation	Wave Length in Meters
3,000- 30,000	High (abbrev. HF)	100-10
30,000- 300,000	Very high (VHF)	10-1
300,000- 3,000,000	Ultra high (UHF)	1-0.1
3,000,000-30,000,000	Super high (SHF)	0.1-0.01

Short waves carry farther without weakening than do regular broadcasting waves. Short waves are generally used to broadcast to foreign countries and other distant places. They are also used by amateurs, and in FM (frequency modulation) broadcasting, in television programs, and for transoceanic telephone conversations. Special equipment is needed to receive short-wave broadcasts. Short waves exhibit such peculiarities as *skip distances* (areas they skip over). PALMER H. CRAIG

See also MICROWAVE; RADIATION (What Radiation Is).

SHORTENING. See BUTTER; LARD; MARGARINE; VEGETABLE OIL.

SHORTHAND is a method of writing rapidly, using symbols or letters to represent the sounds of words. Many words have letters that are not pronounced. In shorthand, a person writes only what he actually hears, regardless of the spelling of a word. For example, the word *people* becomes *pepl* in shorthand. Other short cuts include using a symbol or a combination of symbols or letters to represent whole words or entire phrases of several words.

Shorthand is used chiefly to take dictation. Most people speak at a rate of about 140 words a minute. But a stenographer can take most dictation by writing shorthand at a rate of 80 words a minute. Some stenographic jobs, however, require speeds of 120 or more words a minute. Court reporters must be able to take down conversation at a rate of at least 200 words a minute. The world record for writing shorthand in a contest is held by Martin Dupraw, an American court reporter. In 1927, using the Gregg method, Dupraw took down testimony at a rate of 282 words a minute for five minutes.

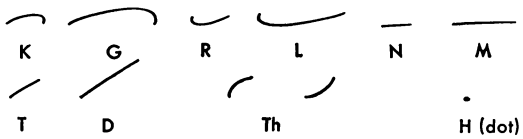
Hundreds of shorthand systems have been developed. The *Gregg* and *Pitman* methods are the best-known systems using symbols. The *Thomas Natural* system, a newer method, is not used so much as the others. *Speedwriting* is the most common of the systems that use longhand letters instead of symbols (see SPEEDWRITING). Several shorthand machines have also been developed, of which the *Stenograph* is the most widely used.

Gregg Shorthand

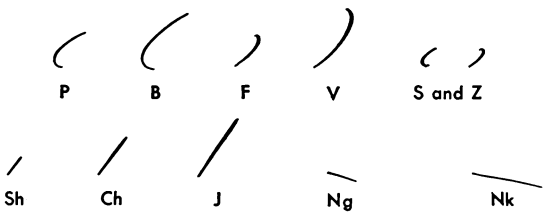
The Gregg method was invented by John Robert Gregg, an educator born in Ireland. It is the most widely used shorthand system in the world. Gregg published his first book, *Light-Line Phonography*, in England in 1888. Gregg later promoted his system in the United States. The symbols are based on longhand strokes and flow along in the same smooth style as longhand writing.

Consonants. Many characters representing consonants in the Gregg system appear in pairs and differ only in length.

Written forward:



Written downward:



Vowels. A large circle, O, represents the sounds of the vowel *a*: ă as in *cat;* ä as in *calm;* ā as in *cane.*

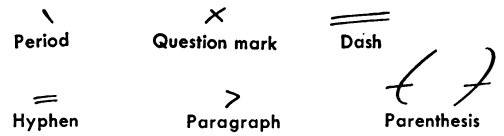
A small circle, o, is used for the following sounds: ĭ as in *hit,* ĕ as in *hen,* and ē as in *greet.*

A hook, ᵕ, is used to indicate the following sounds: ŏ as in *rot,* aw as in *raw* and *bought,* and ō as in *wrote.*

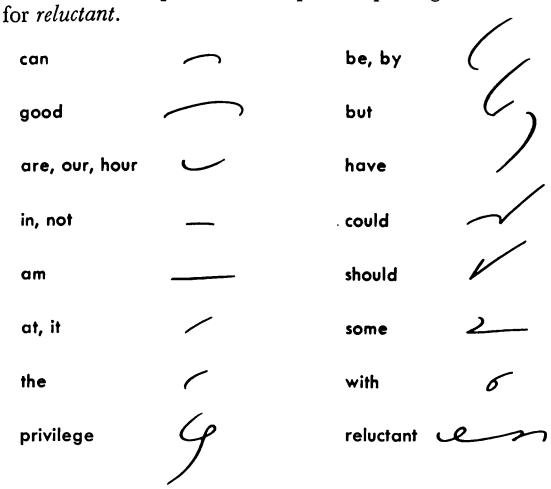
A different hook, ᵔ, is used for these sounds: ŭ as in *duck;* o͞o as in *took*; o͞o as in *pool.*

Diphthongs:

Punctuation:

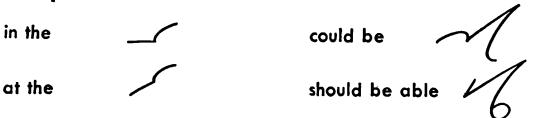


Brief Forms. A person studying the Diamond Jubilee Edition of Gregg shorthand learns the symbols and memorizes 129 *brief forms* that represent common words. The Gregg student learns to write many long words by writing just enough of each word to suggest the entire word. For example, he writes *prev* for *privilege* and *reluk* for *reluctant.*

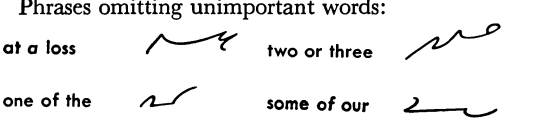


Phrasing. All shorthand systems include many standard phrases. Most shorthand students learn them from a textbook. Most writers also work out their own phrases for expressions used frequently by their employer.

Examples of Phrases:



Phrases omitting unimportant words:



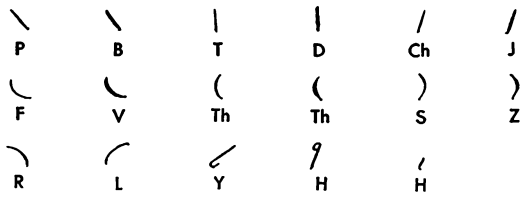
Pitman Shorthand

The Pitman method was invented by Isaac Pitman, an Englishman, in the 1830's. His first shorthand book was published in England in 1837. Pitman shorthand is characterized by the shading of strokes. Some strokes are light and others are heavy or dark. In Pitman shorthand, the position of the symbol *above, on,* or *through*

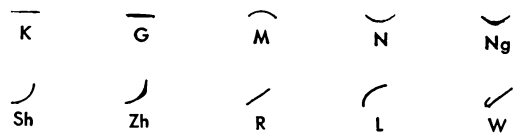
the line further determines the meaning of the word.

Consonants. Many similar-sounding consonants are represented by the same symbol. The shading of the symbol indicates differences in sound.

Written downward:



Written forward:



Circles: S Z

Vowels. When the first vowel in a word has the sound of ă, ah, ŏ, or aw, the outline is written *above* the line. When the first vowel has the sound of ĕ, ā, ŭ, or ō, the outline is written *on* the line. When the first vowel has the sound of ĭ, ē, o͞o, or o͞o, the outline is generally written *through* the line. But there are some exceptions to this rule for writing outlines through the line.

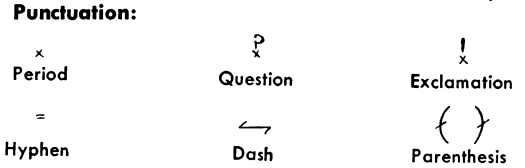
When placed near the beginning of a consonant stroke, a light dot expresses the sound of ă as in *sat*, a heavy dot expresses the sound of ah as in *car*, a light dash expresses the sound of ŏ as in *got*, and a heavy dash expresses the sound of aw as in *talk*.

When placed close to the middle of a consonant stroke, a light dot expresses the sound of ĕ as in *get*, a heavy dot expresses the sound of ā as in *mate*, a light dash expresses the sound of ŭ as in *trust*, and a heavy dash expresses the sound of ō as in *low*.

When placed close to the end of a stroke, the sound of ĭ as in *sit* is shown by a light dot, the sound of ē as in *tea* by a heavy dot, the sound of o͞o as in *foot* by a light dash, and o͞o as in *food* by a heavy dash.

Diphthongs:

Punctuation:



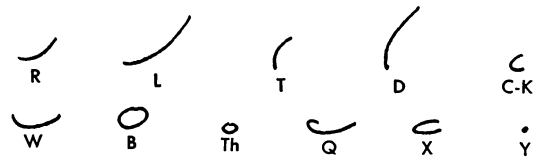
Short Forms. Pitman shorthand has 204 *short forms*. Like the Gregg brief forms, these represent frequently used words and phrases.

Thomas Natural Shorthand

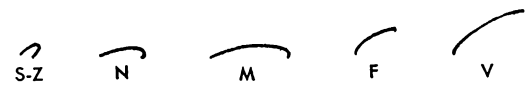
The Thomas Natural system was invented in the 1930's by Charles A. Thomas, an American shorthand teacher. Thomas' first textbook appeared in 1935. It was designed to provide a simpler symbol system. However, the Thomas Natural system never became a widely used system of shorthand. It has only 12 word forms. They correspond to brief forms and short forms. Other words may be shortened by writing the first consonant and one or more other major sounds.

Consonants have definite symbols.

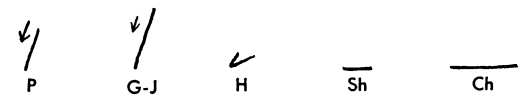
Written counterclockwise:



Written clockwise:



Straight-line strokes:

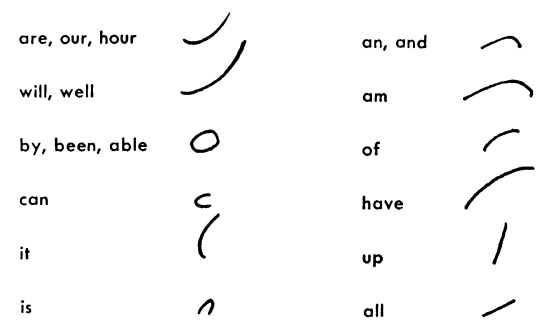


Vowels. The vowel following the first consonant of a word is expressed automatically by simply placing the base of the consonant stroke *above* the line to express *a*, *on* the line to express *e* and short *i*, and *below* the line to express *o*, *oo*, and *u*. Vowels at the beginning of words are expressed in a different manner. They are written as follows:

(Long *i* is always written in this manner).

Punctuation:

Word Signs. These are the 12 memory forms:



A Sample Letter

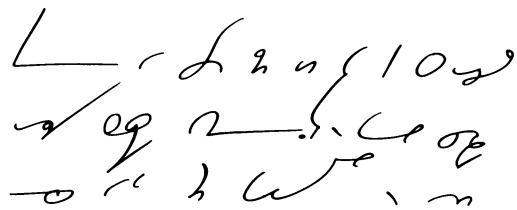
Here is a letter written in the two leading systems of symbol shorthand.

Gentlemen:

The back issue of your publication, which I recently requested, arrived this morning. Please accept my thanks for your promptness.

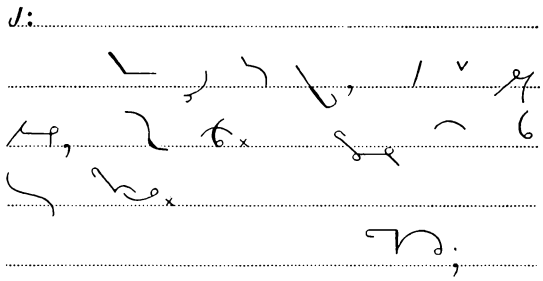
Cordially yours,

Gregg:



All Gregg illustrations courtesy Gregg Div., McGraw-Hill Book Co., Inc.

Pitman:



All Pitman illustrations courtesy Pitman Publishing Corp.

History

Marcus Tullius Tiro, a secretary to the Roman orator Cicero, invented a shorthand system about 50 B.C. During the A.D. 700's, the art of shorthand seemed to disappear. It was revived in England in 1588, when Timothy Bright published his *Characterie: an Art of Short, Swift, and Secret Writing by Character.* This was followed by Peter Bale's *Brachygraphy.* In 1602, John Willis published *The Art of Stenography,* the first attempt at a genuine alphabetical system. Pitman's book in 1837 brought shorthand into worldwide use. Gregg published his book in 1888. Gregg shorthand has been adapted to many languages. DONNA F. ZACK

Related Articles in WORLD BOOK include:

Court Reporter	Pitman, Sir Isaac
Gregg, John Robert	Shorthand Machine
Office Work	Speedwriting

SHORTHAND MACHINE is used to record speech rapidly and accurately. The machine has 21 lettered keys. Any number of letters may be struck at one time. The operator writes numbers by striking a numeral bar and a key bearing the desired number. The numeral bar corresponds to the shift key of a typewriter.

The keyboard is arranged so that the fingers of the left hand print the beginning consonants of a word, the right hand prints the concluding consonants, and the thumbs print the vowels. The letters, C, I, J, M, N, Q, V, X, Y, Z, are omitted. These letters are represented by combinations of other letters that are printed by a single stroke. For example, *M* is represented by the letters *PH.* The letters, P, R, S, and T are in both the left-hand and the right-hand positions on the keyboard.

A shorthand machine operator writes by sounds, much like writers using other shorthand systems. He omits all letters of a word that are not actually pronounced. Many words and phrases can be written with single strokes. He writes multistroke words one syllable at a time. The letters are printed on a narrow paper pad that moves automatically, a line with each stroke. Each letter or number is always printed in the same position on the tape. Anyone familiar with this method can easily transcribe the notes. The sentence: *She was at our house* would be written like this:

```
S   H   E
    W   A         S
        A     T
          O   U R
H   O     U       S
```

There are several different types of shorthand machines in use, such as the Stenograph, Stenotype, and Brevitype. These machines differ in about the same way that a typewriter made by one company differs from that made by another. They are often used for recording speeches and court testimony.

Ward Stone Ireland, a stenographer and court reporter from Dallas, Tex., invented the first shorthand machine, the Stenotype, in 1910. EDWIN R. BOWMAN

See also SHORTHAND; COURT REPORTER.

SHORTHORN. See CATTLE (Beef Cattle; picture).

SHORTSIGHTEDNESS. See NEARSIGHTEDNESS.

SHOSHONE DAM. See BUFFALO BILL DAM.

SHOSHONE FALLS. See IDAHO (Places to Visit; picture).

SHOSHONI INDIANS, *show SHOW nee,* also spelled SHOSHONE, once lived in the desert area of what is now eastern Nevada, southern Idaho, and western Utah. The first white settlers in this region sometimes called the Shoshoni "Snake" or "Digger" Indians. Sacagawea, one of the most famous Indians in American history, belonged to the Shoshoni tribe (see SACAGAWEA).

The Shoshoni lived on some of the most barren land in the United States. They formed small, isolated family groups of eight to ten persons. These groups constantly moved from place to place in search of seeds, roots, fish, birds, and small animals such as rabbits. The Shoshoni planned their journeys so that they could collect each type of plant as it ripened and visit each animal's favorite haunt. They returned to the same areas once each year. One family referred to another according to the main food of a region. There were Seed Eaters, Rabbit Eaters, and so on. If people had an abundance of food, families gathered together where the winter was mild to form a camp. They spent much of the time singing, dancing, and telling stories. If the winter was severe and food was scarce, they often abandoned the sick, the aged, and the newborn babies.

Some of the Shoshoni acquired horses from the Spaniards, and became buffalo hunters like the Plains tribes. Well-known leaders of these Shoshoni included the chieftains Pocatello and Washakie (see WASHAKIE). The Shoshoni now live as ranchers and farmers in Wyoming, Nevada, and Idaho. CHARLES E. DIBBLE

SHOSTAKOVICH, *SHAHS tuh KOH vihch,* **DIMITRI** (1906-1975), was an important Soviet composer. Many critics believe his bold, expressive style represents mod-

ern Russian music at its finest. Shostakovich became best known for his 15 symphonies but also won fame for ballets, concertos, string quartets, songs, and an opera. One of his most popular pieces is the witty "Polka" from the ballet *The Golden Age* (1930).

Shostakovich was born in St. Petersburg (now Leningrad) and attended the Leningrad Conservatory. He was a brilliant pianist but chose to concentrate on composing. For his graduation from the conservatory, Shostakovich wrote his *Symphony No. 1* (1926), which gained international recognition.

During the mid-1930's, Shostakovich developed a sophisticated modern style that displeased Soviet authorities. In 1936, they denounced his opera *Lady Macbeth of Mtsensk* as "chaos instead of music." But in 1937, Shostakovich composed his great *Symphony No. 5*, which restored him to favor with the government. In 1941, during World War II, Shostakovich wrote the famous *Symphony No. 7*. He dedicated it to Leningrad, which was under siege by the German Army.

In 1948, Shostakovich suffered renewed government criticism for his style of composing. But after the death of Soviet dictator Joseph Stalin in 1953, he felt free to compose as he pleased. During the late 1950's, Shostakovich composed works on specific subjects. In his *Symphony No. 11* (1957), for example, he created a musical portrait of the Russian Revolution of 1905. He based his *Symphony No. 13* (1962) on five poems by the Russian poet Yevgeny Yevtushenko. This symphony is nicknamed *Babi Yar*, the title of one of the poems. In 1962, Shostakovich revised *Lady Macbeth of Mtsensk* as *Katerina Ismailova*. The opera now ranks as one of his masterpieces. BORIS SCHWARZ

SHOT. See SHOTGUN.

SHOT-PUT is a test of strength in track and field meets. In ancient days, athletes used a heavy stone in the shot-put. Present-day athletes use an iron ball. Senior athletes use a 16-pound (7.3-kilogram) ball, high-school boys use one of 12 pounds (5.4 kilograms), and beginners use 8-pound (3.6-kilogram) balls.

Success in shot-putting depends upon ability to get the whole force of the body behind the heave. The put is made from a circle 7 feet (2.1 meters) in diameter. An arc-shaped wooden stopboard usually forms the front of the circle. Standing at the back of the circle, the shot-putter balances the shot in his fingers. Then he hops, or *glides*, forward until his leading foot is near the stopboard. He propels the shot, and as he does so, the momentum forces him to turn his body so that the positions of his two feet are reversed and so that his weight is well forward on the other foot. His arm thrusts out in a long follow-through. The shot can be sent into the air most effectively at an angle of 40 degrees. The measurement is made from the nearest edge of the first break of ground to the nearest point on the inside edge of the shot-put circle. FRED RUSSELL

See also TRACK AND FIELD.

SHOT TOWER is a structure used to make small shot for firearms. In colonial days, shot towers were wooden or brick towers 50 to 100 feet (15 to 30 meters) high. The men poured melted lead through a vessel at the top of the tower that had holes in it. As each piece of lead dropped, it formed a round ball. It cooled in this shape when it landed at the bottom in a vessel containing cold water. Today, most shot is made in towers that are up to 190 feet (58 meters) high. JOHN D. BILLINGSLEY

SHOTE. See HOG (Hog Terms).

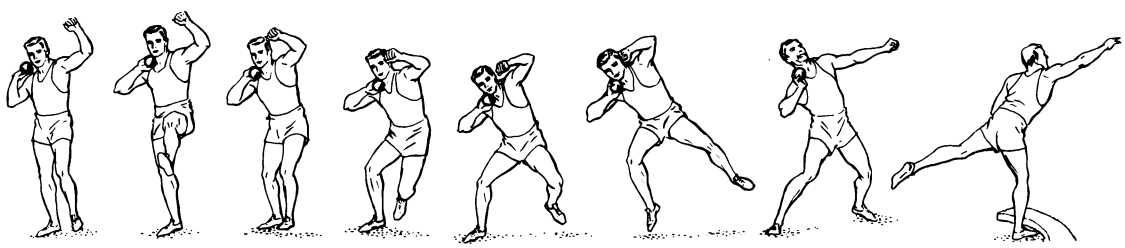
SHOTGUN is a shoulder gun that fires a cartridge that contains a powder charge and a load of lead pellets, called *shot*. The shot spreads over a wide area. This makes it easier to hit a moving target with a shotgun than with the single bullet from a rifle or a pistol. Sportsmen prefer shotguns for hunting flying and running game. The shotgun is chiefly a hunting gun. Small shotgun pellets are called *bird shot*. Larger ones, called *buckshot*, are used to shoot such animals as deer.

The size of a shotgun is measured by *bore*, or *gauge*. The weight of the lead ball required to fit the muzzle of the gun is the standard of measurement for the bore. If a bullet weighing $\frac{1}{12}$ pound (38 grams) fits the bore, the shotgun is called a 12-bore, or a 12-gauge, gun. Popular gauges are 10, 12, 16, 20, 28, and .410.

The amount of spread in the shot is controlled by the *choke*. If a barrel will put 70 per cent of its shot charge in a 30-inch (76-centimeter) circle at 40 yards (37 meters), it is called *full choke*. *Modified choke* will deliver about 60 per cent; *improved cylinder* about 50 per cent. A full choke 12-gauge gun will kill ducks that are about 60 to 65 yards (55 to 59 meters) away.

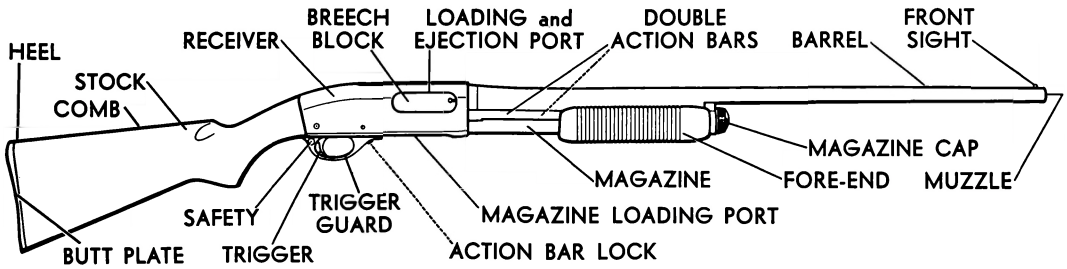
The first shotgun, developed in 1537, was loaded with small shot instead of one round ball. In 1831, Augustus Demondion patented a cartridge that held small shot. Modern shotguns are single barrels, double barrels, or single barrels with automatic repeating magazines that hold several cartridges. Repeating shotguns are popular in the United States. JACK O'CONNOR

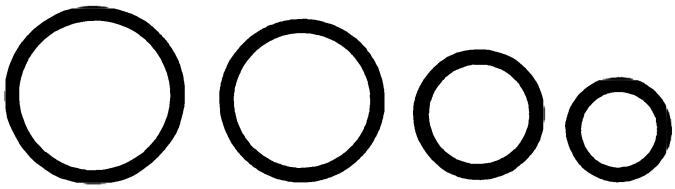
See also FIREARM; HARQUEBUS; SHOT TOWER; SKEET.



A Shot-Putter holds the shot against his neck with one hand and extends the other arm to maintain his balance. The drawings above show how he swings one leg for balance and momentum, then glides across the ring, and pushes the shot away to release it.

MAIN PARTS OF A PUMP ACTION SHOTGUN





Remington Arms Co., Inc.

The Gauge of a Shotgun indicates the size of its bore. Gauge is determined by the number of round lead balls, each the size of the bore, that are needed to weigh 1 pound (0.5 kilogram). If 10 balls are needed, the shotgun is a 10 gauge. The only exception is the 410 bore, which is .410 inch (10.4 millimeters) in diameter and 67.5 gauge.

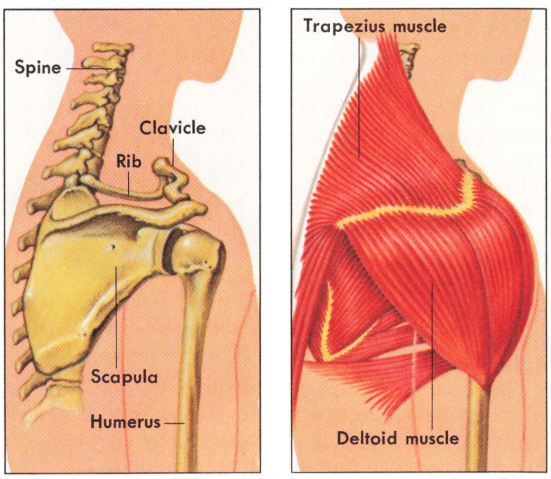
SHOTOKU, PRINCE. See JAPAN (Early History).

SHOULDER is the part of a person's body between the neck and the arm. It includes bones and muscles that attach the arm to the trunk. The shoulder consists of two bones—the broad, flat *scapula* (shoulder blade) and the slender *clavicle* (collarbone). The largest muscle of the shoulder, the *deltoid* muscle, raises the upper arm.

Joints in the shoulder enable the upper arm to move. The *humerus* (bone of the upper arm) has a round head that fits into a shallow depression of the scapula, forming the shoulder joint. Near the tip of the shoulder, a joint formed by the clavicle and the scapula permits the scapula to twist. Such twisting allows greater arm motion than would the shoulder joint alone.

The shoulder joint can be dislocated more easily than any other joint. A fall on an outstretched arm, or a hard push from behind, can cause a dislocated shoulder. Many athletes suffer this injury. LEONARD MARMOR

See also COLLARBONE; JOINT; HUMAN BODY (picture).



WORLD BOOK illustration by James Teason

The Shoulder consists of two bones, the *clavicle* and *scapula, left,* and various muscles, *right.* The *humerus,* the upper arm bone, forms a ball-and-socket joint with the scapula. The *deltoid muscle,* one of the largest shoulder muscles, helps move the upper arm. The *trapezius* muscle helps rotate the scapula.

SHOUP, *shoop*, GEORGE LAIRD (1836-1904), was the first governor of Idaho. He volunteered for the Union Army during the Civil War, and rose to the rank of colonel. He helped found Salmon, Idaho, in 1866, and was successful as a merchant there. He served in the territorial legislature, and was appointed territorial governor by President Benjamin Harrison. When Idaho was admitted to the Union in 1890, Shoup was elected governor. But he resigned to serve as a Republican in the United States Senate from 1890 to 1901. He was born in Kittanning, Pa. NELSON M. BLAKE

SHOVELBOARD. See SHUFFLEBOARD.

SHOVELER, or SPOONBILL, is a small duck of the Northern Hemisphere with a spoon-shaped bill. It lives in North America, Europe, and Asia in summer, and migrates south in winter to Colombia, North Africa, and southern Asia. The upper portion of the bill overhangs the lower. The male has a green head, white breast, and blue-and-chestnut-colored body. The shoveler feeds in shallow water on mollusks, insects, and roots. It takes a mouthful and strains the mud and water out through "gutters" in the sides of its bill, leaving the food inside. Shovelers nest on the ground, sometimes quite a distance from water. The female lays from 6 to 14 pale-greenish to bluish-white eggs.

Scientific Classification. The shoveler belongs to the duck family, *Anatidae*. It is classified as genus *Anas*, species *A. clypeata*. JOSEPH J. HICKEY

See also BIRD (picture: Wild Ducks and Wild Geese).

SHOW. See CIRCUS; DOG (Dog Shows); FAIRS AND EXPOSITIONS; FLOWER (Flower Shows); INTERNATIONAL LIVE STOCK EXPOSITION; MOTION PICTURE; THEATER.

SHOW ME STATE. See MISSOURI.

SHOWA. See HIROHITO.

SHRAPNEL is a form of artillery shell invented by Lieutenant (later, Lieutenant General) Henry Shrapnel (1761-1842). The shell contained a number of balls and a charge of powder that burst the shell. The British

Army used the first shell of this type in Surinam in 1804. During World War I, shrapnel was considered one of the most reliable and effective antipersonnel shells. Since World War II, the word commonly refers to the steel fragments of the shell casing hurled by an explosive charge, although some types of shells filled with metal fragments are still used. See also AMMUNITION; ARTILLERY.

JOHN D. BILLINGSLEY

SHREVEPORT, La. (pop. 182,064; met. area 333,826), is an industrial center and Louisiana's second largest city. It is on the Red River in the northwestern part of the state. It is about 310 miles (499 kilometers) northwest of New Orleans and 190 miles (306 kilometers) east of Dallas, Tex. (see LOUISIANA [political map]). For the monthly weather in Shreveport, see LOUISIANA (Climate).

Shreveport developed rapidly after the Caddo oil field was discovered in 1906. Today, the natural gas in this region furnishes fuel for the city's factories. Shreveport has cotton gins, cottonseed-oil mills, glass plants, oil refineries, iron and steel foundries, railroad shops, and wood-products factories. The city is the home of the Louisiana State Fair, Centenary College of Louisiana, and a branch of Southern University. Barksdale Air Force Base is located nearby.

The town was founded in 1835 as Shreve's Landing. It was named after Henry Miller Shreve, who opened the Red River to navigation. During the last two years of the Civil War, it was the state capital. It has a commission government and is the seat of Caddo Parish.

SHREW, *shroo,* is a small animal that looks like a sharp-nosed mouse. Some shrews are among the smallest known mammals, weighing as little as an American penny. Shrews live in both the Eastern and Western hemispheres. They make their homes in fields, woodlands, gardens, and marshes.

Shrews are often mistaken for mice because of their small size. Shrews have long, slender snouts which they can move to explore small holes and crevices for food. Their eyes and ears are tiny, and their bodies are covered with short, dark hair. One of the largest shrews in America is the *water shrew,* which is 6 inches (15 centimeters) long. The smallest, the *pygmy shrew,* is about $3\frac{1}{2}$ inches (8.9 centimeters) long.

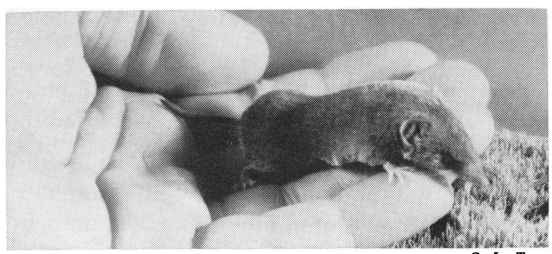
Shrews eat insects and worms chiefly, but they sometimes kill and eat birds and other small creatures. They even attack mice larger than themselves. They are fierce fighters. The bite of some shrews is poisonous to their prey. Shrews must eat almost continuously during the day to satisfy their high energy requirements.

Weasels, foxes, and owls prey upon the shrews. But the shrew's strong musky odor protects it against enemies. The *short-tailed shrew,* which lives in the eastern United States, eats snails. The *masked shrew* is found in the northern United States and in Canada. It usually lives near marshes and streams.

Shrews are harmless to man. They are useful in gardens, for they eat insects and grubs.

Scientific Classification. The shrew belongs to the shrew family, *Soricidae.* The water shrew is classified as genus *Sorex,* species *S. palustris.* The short-tailed shrew is *Blarina brevicauda.*

FRANK B. GOLLEY



Cy La Tour

The Tiny Shrew can fit in the palm of the hand, but it is a big eater. It eats about three times its own weight each day.

See also TREE SHREW.

SHREWSBURY SCHOOL, *SHROOZ ber ih,* founded by King Edward VI in 1552, ranks as one of England's famous public schools. It is in Shrewsbury. After a period of decline in the 1700's, two great headmasters restored the school to a leading position. Samuel Butler, who served from 1798 to 1836, raised the standards of scholarship. Benjamin Kennedy, headmaster from 1836 to 1866, added modern studies and encouraged interest in music and sports.

R. W. MORRIS

SHRIKE is a bird that can be recognized by its strong, slightly hooked beak, and by its habit of thrusting grasshoppers, mice, and smaller birds onto thorns, barbs, or twigs, much as a butcher hangs meat. The shrike then tears its prey to pieces and eats it. From this habit comes its common name of *butcherbird.*

There are two species in North America: the *northern shrike,* or *butcherbird,* and the *loggerhead shrike.* The northern shrike ranges from the far north in summer to Kansas and Virginia in the winter. The loggerhead shrike nests in Mexico and northward to southern Canada, and travels south for the winter. Both species have feathers of gray, black, and white. Their nests are built of grass and small sticks in bushes or low trees. Shrikes are often seen in summer along country roads. The female lays 4 to 8 eggs. They are dull- or grayish-white, and are thickly marked with brown and lavender. The northern shrike is about 10 inches (25 centimeters) long, and the loggerhead shrike is about 9 inches (23 centimeters) long.

Charles W. Schwartz

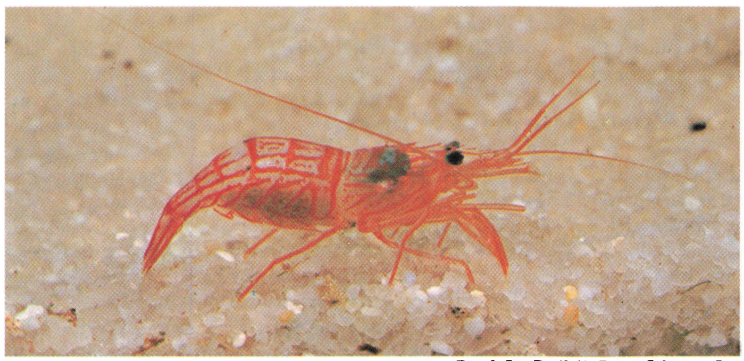
A Young Northern Shrike

The shrike's name may be an imitation of its harsh call notes, which are screeches or shrieks. But its song is a sweet warble. Shrikes are protected by law, because they destroy insects and predatory mammals.

Scientific Classification. The shrike belongs to the family *Laniidae.* The northern shrike is classified as genus *Lanius,* species *L. borealis;* the loggerhead shrike is *L. ludovicianus.*

LEON A. HAUSMAN

See also BIRD (color picture: Birds That Help Us).



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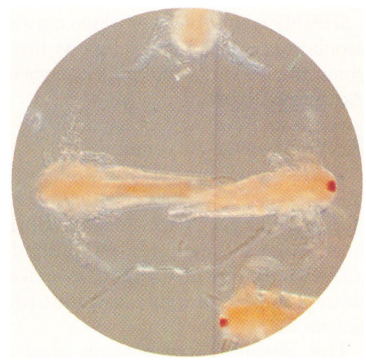


Runk/Schoenberger from Grant Heilman

Shrimp are shellfish related to crabs and lobsters. An adult shrimp of the genus *Lysmata, left,* has a bright-colored, striped body. The tiny, almost transparent larvae of the brine shrimp, *right,* have a dark eyespot and fewer legs than the adults. They have been magnified 50 times.

SHRIMP are slender shellfish related to crabs and lobsters. Shrimp are a popular food and make up the most valuable catch of United States fishermen.

Shrimp live in fresh and salt water in nearly all parts of the world. Some species live near the shore, where they hide in the mud by day and feed by night. Others swim about in groups in deep, cold water. A shrimp generally swims forward. It can swim backward by flipping its fan-shaped tail.

Most shrimp have gray, brown, white, or pink bodies. But some are red, yellow, green, or blue, and some have stripes. Some can change color to match their surroundings. Many species are *luminescent* (light-producing).

The smallest kinds of shrimp measure less than 1 inch (2.5 centimeters) long. Some giant fresh-water species grow more than 1 foot (30 centimeters) long and have feelers equally as long. Large shrimp are sometimes called *prawns*.

Small shrimp eat *plankton* (small drifting plants and animals). Large shrimp feed on material on the sea floor. Shrimp, in turn, serve as an important food for fish and other water animals. Some shrimp eat parasites from the gills and scales of fish. Groups of fish gather near these shrimp awaiting such cleaning.

The Body of a Shrimp has two main parts, the *cephalothorax* (head and chest) and the *abdomen*. An unjointed shell covers the cephalothorax. A shrimp can bend because the shell of the abdomen is jointed.

Most shrimp have 19 pairs of jointed legs, feelers, and other *appendages*. The cephalothorax has two pairs of feelers, which taste the water to locate food; a pair of appendages that serve as jaws; five pairs of appendages that handle food; and five pairs of walking legs. The abdomen has five pairs of fanlike *swimmerets*, which are used in swimming and reproduction. It also has a pair of appendages that form part of the shrimp's tail.

Some kinds of shrimp have claws on their two front pairs of walking legs. A shrimp uses its claws to gather food and to fight. The pistol shrimp makes a sound like a gunshot by snapping one of its claws.

Shrimp *molt* (shed their shells) many times during their lives. A new and larger shell hardens after each molt. If any appendages have been lost, new ones develop during the course of several molts.

The Life of a Shrimp. Various species of shrimp have different life cycles. Some live only a year, but others may live five years or more. Some females carry their eggs in their swimmerets until they hatch. Others lay their eggs and swim away. Some shrimp do not swim about but live in burrows that they dig in sand or mud.

The most common kinds of United States food shrimp, *peneid* shrimp, hatch from eggs laid in the ocean up to 100 miles (160 kilometers) offshore. A newly hatched peneid shrimp resembles a tiny pear with legs. It changes shape about 15 times until, after two to four weeks, it looks like an adult shrimp. A newly hatched shrimp of any species is called a *larva*.

Young peneid shrimp move toward shore as they develop, but 80 per cent or more may be eaten by sea animals along the way. The survivors settle in bays and river mouths. After about five to seven months near shore, the shrimp begin a two-month trip back to deeper water. They breed in deep water, and each female lays 500,000 to 1,000,000 eggs. Scientists believe that most of the adults die soon after the eggs are laid.

Members of another important group of shrimp, the *pandalids*, all begin life as males. At about 2 years of age, they change to females.

Water pollution and the filling in of bays for housing developments have reduced the number of shrimp living near some seacoasts. If shrimp become less plentiful, the fish that feed on them may also decrease.

The Shrimp Industry. Fishermen use pouch-shaped nets called *trawls* to catch shrimp. They drag the trawls over the sea bottom. The catch is frozen or canned as quickly as possible on the boat or ashore.

The United States leads the world in shrimp production. Louisiana, Texas, and Florida rank as the leading shrimp-producing states, in that order. Fishermen from India, Japan, Thailand, Korea, Mexico, and many other countries also catch large amounts of shrimp. More than half the world's catch comes from Asia.

Some Japanese raise shrimp in large tanks and ponds. Florida has such shrimp "farms," but they had not become profitable by the early 1970's.

Scientific Classification. Shrimp belong to the class *Crustacea*.

CLARENCE P. IDYLL

See also FISHING INDUSTRY.

SHRINE is an object or place considered sacred for its associations. All major religions have sacred places to which the devout make pilgrimages to give thanks or to ask divine favors.

See also KAABA; LOURDES; OUR LADY OF FATIMA; SAINTE-ANNE-DE-BEAUPRÉ.

SHRINE is an organization related to the Masons. Its full name is *The Ancient Arabic Order of Nobles of the Mystic Shrine for North America.* Shriners are noted for the hospitals they have established for crippled and burned children in Canada, Mexico, and the United States. These children's hospitals provide free medical treatment.

The Shrine has the same aims and ideals as the Masons. It admits men who are at least 32nd-degree Masons in the Scottish Rite or Knights Templar in the York Rite. The Shrine was founded in 1872 by two Americans, Walter M. Fleming, a physician, and William J. Florence, an actor. Critically reviewed by THE SHRINE

See also MASONRY.

SHRIVER, SARGENT (1915-), was the Democratic nominee for Vice-President in 1972. Senator George S. McGovern of South Dakota and Shriver were defeated by President Richard M. Nixon and Vice-President Spiro T. Agnew. In the 1960's, Shriver had served as the first director of the Peace Corps and of the Office of Economic Opportunity (OEO).

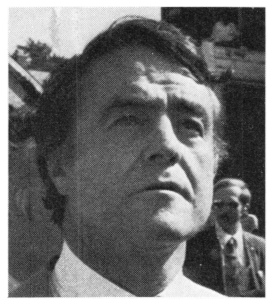
Early Life. Robert Sargent Shriver, Jr., was born on Nov. 9, 1915, in Westminster, Md. He graduated from Yale University in 1938 and earned a law degree at the Yale Law School in 1941. He served as a naval officer during World War II (1939-1945).

In 1946, Shriver joined the business organization of Joseph P. Kennedy. Kennedy was the father of John F. Kennedy, who became President in 1961. In 1948, Shriver became assistant general manager of the Merchandise Mart in Chicago, which the elder Kennedy owned.

In 1953, Shriver married Eunice Kennedy (1921-), the third oldest daughter of Joseph Kennedy. The Shrivers had five children—Robert Sargent III (1954-), Maria (1956-), Timothy (1960-), Mark (1964-), and Anthony (1965-).

From 1955 to 1960, Shriver served as president of the Chicago Board of Education. He played a key role in his brother-in-law's 1960 presidential campaign.

Government Career. From 1961 to 1966, Shriver directed the Peace Corps under Presidents Kennedy and Lyndon B. Johnson. In 1964, Johnson named Shriver director of the OEO. Johnson appointed him United States ambassador to France in 1968, and Shriver continued in that post under President Nixon until March, 1970. He later joined a private law firm.



United Press, Int.
Sargent Shriver

In 1972, Shriver replaced Senator Thomas F. Eagleton of Missouri as McGovern's running mate. Eagleton had resigned from the ticket after revealing that he had been hospitalized three times for treatment of emotional exhaustion and depression. DAVID S. BRODER

SHROPSHIRE. See ENGLAND (political map).

SHROUD OF TURIN, *TOO rin,* is a cloth 14 feet (4.3 meters) long by 3½ feet (1.1 meters) wide, kept in Turin, Italy. Tradition claims that it wrapped Jesus' body in the tomb after His crucifixion. Photographic reversal of the lights and shadows of the stains on the shroud (which are largely negative) reveals a life-size front and back figure of a man who was crucified, scourged, lanced, and bloodily crowned. FRANCIS L. FILAS

SHROVE TUESDAY is the day before Ash Wednesday, the beginning of Lent. Its name came from the old custom of confessing (being *shriven*) on that day. Shrove Tuesday is a time of rejoicing in many countries and communities. It is the last day of the *carnival* season of southern Europe, and corresponds to the *Mardi Gras* of the French and the *Pancake Tuesday* of the English. See also CARNIVAL; MARDI GRAS. FULTON J. SHEEN

SHRUB is one of the four main groups of plants in terms of size and form A shrub is a perennial with woody stems that is smaller than a tree. Shrubs usually have several low stems branched near the ground. They also are called *bushes,* especially if they have many branches (see BUSH). Trees have one large stem, the trunk. Shrubs differ from vines because they stand up without support, and do not climb. They differ from herbs because they have hard, woody, long-lived stems. Shrubs grow in almost all parts of the world. They provide cover and food for birds and game, and protect the soil from erosion. Shrubs are popular for ornamental planting along foundations of houses, in gardens, and as hedges around lawns. Many shrubs produce fragrant blossoms, or decorative leaves, twigs, and fruits.

Most shrubs will grow in well-drained soil, spaded to a depth of 1½ to 2 feet (46 to 61 centimeters). Smaller plants may be spaced 2 to 3 feet (61 to 91 centimeters) apart, the larger ones 6 feet (1.8 meters) apart. Transplanting may be done in fall or spring. For best growth, prune old branches. ELBERT L. LITTLE, JR.

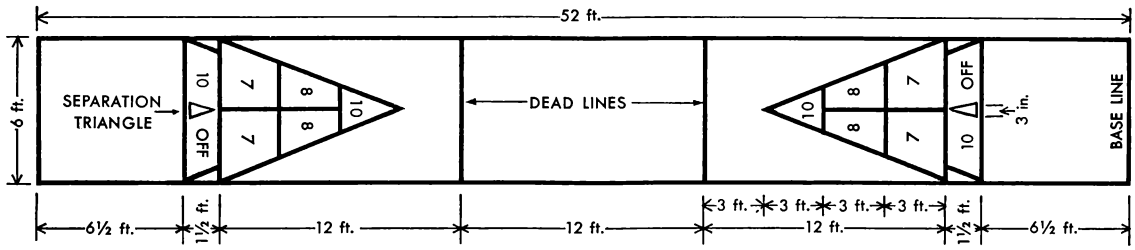
For a list of WORLD BOOK articles on shrubs, see the *Related Articles* at the end of the PLANT article.

SHRUBBY ALTHEA. See ROSE OF SHARON.

SHUFFLEBOARD, or SHOVELBOARD, is a game played on smooth surfaces, such as pavements, gymnasium floors, and ship decks. The object of the game is to push wooden or metal disks into scoring areas, and to knock the opponent's disks out of scoring areas. A player pushes the disks with a *cue* (a stick with a wide end).

Two persons can play shuffleboard against each other, or four persons can form two opposing teams. Each side has four disks. The players take turns shooting from the 10-off space. A player scores 10 points for each disk in the 10-area; eight points for the 8-area; and seven points for the 7-area. Ten points are subtracted for each disk in the 10-off space. After all the disks have been pushed, the players add up their scores and move to the other end of the court and continue play. The winning score may be 50, 75, or 100 points. The winner is the team with the highest scores in two out of three games.

A shuffleboard disk is 6 inches (15 centimeters) in diameter. The cue may be no longer than 75 inches (191 centimeters). The head of the cue is shaped like a half-moon. An official court is 52 feet (16 meters) long and



Shuffleboard Can Be Played on a Smooth, Narrow Surface, Such as a Ship's Deck.

6 feet (1.8 meters) wide. Two triangles 18 feet (5.5 meters) apart form the scoring areas. DOROTHY DONALDSON

SHULEVITZ, URI (1935-), a book illustrator, won the 1969 Caldecott medal for his illustrations for *The Fool of the World and the Flying Ship*. This story is based on an old Russian folk tale.

Shulevitz was born in Warsaw, Poland. He fled Poland with his family in 1939, soon after the German invasion. After wandering through Europe for eight years, the family settled in Paris in 1947. Shulevitz lived in Israel from 1949 to 1959, when he moved to New York City. He published his first children's book, *The Moon in My Room*, in 1963.

See also LITERATURE FOR CHILDREN (picture: A Russian Folk Tale).

SHULL, GEORGE H. See CORN (Improving Corn).

SHULTZ, GEORGE PRATT (1920-), held several important positions in the Administration of President Richard M. Nixon. From 1972 to 1974, Shultz served as secretary of the treasury and chairman of the Council on Economic Policy. During that period, he was responsible for coordinating decisions affecting the government's economic policy. Shultz had served as Nixon's secretary of labor in 1969 and 1970 and as director of the Office of Management and Budget from 1970 to 1972.

Shultz was born in New York City. He graduated from Princeton University in 1942 and received a Ph.D. degree from the Massachusetts Institute of Technology (M.I.T.) in 1949. From 1948 to 1957, Shultz taught economics at M.I.T. He became a professor of industrial relations at the University of Chicago in 1957 and dean of the graduate school of business in 1962.

Shultz has served in the United States and abroad as an adviser to governments and to management and labor groups. As an arbitrator in labor disputes, he became noted for his fairness and his ability to bring about settlements. CLARK R. MOLLENHOFF

SHUNT. See AMMETER.

SHUNT MOTOR. See ELECTRIC MOTOR (Kinds).

SHUSH. See SUSA.

SHUTTER. See CAMERA (How a Camera Works).

SHUTTLE. See WEAVING (Weaving on a Loom).

SHUTTLECOCK. See BADMINTON (picture).

SHYLOCK. See SHAKESPEARE, WILLIAM (Shakespeare's Plays [The Merchant of Venice]).

SI. See METRIC SYSTEM.

SI KIANG, *SHE jih AHNG*, or WEST RIVER, is the most important stream of southern China. The Si Kiang rises on the border of Yunnan and Kweichow provinces and flows southeast for about 1,650 miles (2,655 kilometers). It empties into the South China Sea. Canton, one of China's largest cities, is on the delta formed by the Si Kiang and smaller rivers. Steamships can sail 230 miles (370 kilometers) up the Si Kiang to the city of Wuchow. L. CARRINGTON GOODRICH

SI-LING-SHI. See SILK (History).

SIALKOT, *see AHL koht* (pop. 212,000), or SEALKOTE, is an industrial and trading center in Pakistan (see PAKISTAN [political map]). Factories in the city make sporting goods, surgical instruments, and metal products. Cotton ginning, weaving, tanning, flour milling, and food processing are also important industries in Sialkot. The city is a distribution center for the agricultural products produced nearby. Sialkot has a technical institute. The city grew up on the site of a fortress built in 1181. ROBERT I. CRANE

SIAM. See THAILAND.

SIAMESE CAT. See CAT (Siamese Cats; color picture).

SIAMESE TWINS. See TWINS.

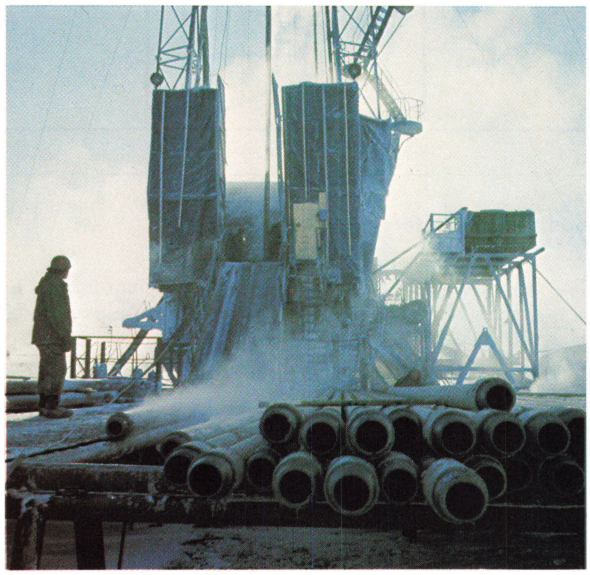
SIBELIUS, *sih BAY lih us*, **JAN** (1865-1957), was a Finnish composer. His most important works are his seven symphonies and many symphonic poems for orchestra. Sibelius based most of his symphonic poems on Finland's national epic poem, the *Kalevala*. These compositions express Sibelius' impressions of Finland's forests, lakes, cool summers, and snowy winters.

Sibelius' earlier and more melodious compositions became his most popular works. They include *The Swan of Tuonela* (1893), *Finlandia* (1900), *Second Symphony* (1902), and *Valse Triste* (1903). Sibelius developed a less melodious style after about 1904. His *Fifth Symphony* (1915) is the best introduction to his later style of composing. In both his earlier and later symphonies, Sibelius first stated his themes in fragmentary form. He developed the themes during the composition and presented them in complete form near the end of the work.

Sibelius was born in Hämeenlinna. He studied music at the Helsinki Conservatory and then, from 1889 to 1892, in Berlin and Vienna. The government awarded Sibelius a pension in 1897, enabling him to devote himself to composing.

Sibelius' most famous work, *Finlandia*, was first performed in 1900 in Helsinki. At that time, Russia ruled Finland. *Finlandia* expressed so much national pride and patriotism that for many years the Russians refused to permit its performance. But the work became the anthem of the Finnish independence movement. Finland gained its independence from Russia in 1918.

During the early 1900's, Sibelius became internationally known as a composer and conductor. But he stopped composing in 1929 because he disliked the new trends in composition and did not wish to write in the modern styles. R. M. LONGYEAR



Drillers Sink an Oil Well into the frozen ground at Samotlor, a Siberian oil field near the Ob River, about 450 miles (720 kilometers) northwest of Novosibirsk. Wells along the Ob supplied about a fourth of Russia's petroleum during the 1970's.

Howard Sochurek, Woodfin Camp, Inc.

Novosibirsk is Siberia's biggest city and one of the largest in Russia. The city was founded in 1893 and expanded rapidly after the government established many factories there during World War II (1939-1945).

SIBERIA is a vast, thinly populated region in northern Asia. It lies entirely within Russia. Siberia makes up about half the area of Russia, but only a tenth of the Russian people live there. Ice and snow cover most of the region about six months a year, and the temperature sometimes drops below −90° F. (−68° C).

Through the centuries, Russian rulers have sent millions of criminals and political prisoners to isolated parts of Siberia. Many of these people were forced to work as laborers building factories, mines, and railroads. During the 1960's and 1970's, Russia began to use extensive Siberian deposits of coal, oil, natural gas, and other minerals.

The Land and Climate

Siberia covers about 4,246,000 square miles (10,997,000 square kilometers). It has three main areas—the West Siberian Plain, the Central Siberian Plateau, and the East Siberian Highlands. The West Siberian Plain, a flat area of swampy forests, extends from the Ural Mountains to the Yenisey River. The Central Siberian Plateau lies between the Yenisey and Lena rivers. Lake Baykal, the world's deepest lake, lies on the southern edge of the plateau. This lake is 5,712 feet (1,741 meters) deep. The East Siberian Highlands consist of a series of mountain ranges between the Lena River and the Pacific coast. This area includes Siberia's highest point, an active volcano named Klyuchevskaya that rises 15,584 feet (4,750 meters).

WORLD BOOK map

Location of Siberia

Moss, lichens, and a few kinds of small shrubs grow in the *tundra*, a narrow belt of vegetation along Siberia's Arctic coast. South of the tundra, a vast evergreen forest called the *taiga* spreads from the Urals to the Pacific coast. In the extreme southwest lie the *steppes* (grasslands), Siberia's richest farming area.

Arctic foxes, lemmings, and reindeer live in the tundra; and ermines, lynxes, red foxes, and sables make their home in the taiga. Fishermen catch cod, crabs, and salmon off the Pacific coast.

Average temperatures in northeastern Siberia range from −59° F. (−51° C) in January to 59° F. (15° C) in July. In the steppes, temperatures vary from 3° F. (−16° C) in January to 64° F. (18° C) in July. The annual *precipitation* (rain, melted snow, and other moisture) averages 5 inches (13 centimeters) in the north. In the steppes, it averages 31 inches (80 centimeters). A layer of permanently frozen ground called *permafrost* covers most of eastern Siberia.

The People

Siberia has a population of 32,105,000, but the region has a population density of only 8 persons per

square mile (3 persons per square kilometer). European Russia is more than 10 times as densely populated. Siberia's population has grown slowly. During some years, because of the harsh living conditions, more people leave than move there.

The use of forced labor for Siberian construction projects ended after the Russian dictator Joseph Stalin died in 1953. Since then, the government has tried to attract workers to Siberia by offering such rewards as high salaries and long vacations. But many workers stay only a few years before returning to the better living conditions in other parts of Russia.

Most Siberians are Russians. The government has moved many settlers into the region since the 1700's. Such Mongol and Turkic groups as Buryats, Tuvinians, and Yakuts lived there originally.

About three-fourths of Siberia's people live in cities, and the rest live in rural areas. Most of the city people are crowded into small apartments. Many people in rural areas live in simple, but more spacious, log houses. Siberia's largest city is Novosibirsk. Other large cities include Irkutsk, Khabarovsk, Sverdlovsk, and Vladivostok, a major port.

Economy

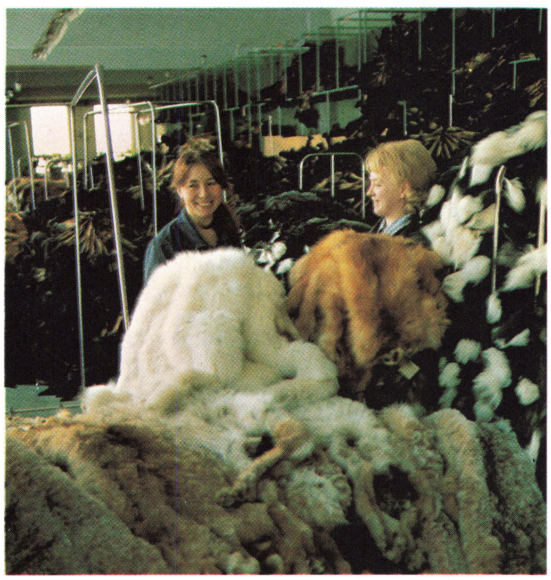
Siberia has an abundance of natural resources. Many minerals, including diamonds, gold, platinum, tin, and tungsten, are mined in harsh, isolated areas in Siberia. Vast oil fields along the Ob River began operating in 1965. By the mid-1970's, the fields produced about a fourth of Russia's oil. About a third of the country's coal comes chiefly from deposits in the Kuznetsk Basin. In the early 1970's, Russia began to develop extensive natural gas reserves near the Arctic coast in western Siberia, and also around Yakutsk in the east. Siberian forests produce about a third of the nation's timber.

About a fifth of Russia's electric power comes from hydroelectric dams on Siberia's great rivers. The world's largest power dam, Krasnoyarsk Dam on the Yenisey River, generates 6 million kilowatts of power.

Siberian manufacturing is centered mainly in the Kuznetsk Basin. Leading products include building materials, chemicals, and farm machinery. The southern steppes include the region's most productive farmlands. Farmers there grow barley, oats, and wheat. Livestock raised in Siberia include cattle, sheep, and reindeer, and the region has many dairy farms.

The Trans-Siberian railroad, which crosses southern Siberia, carries passengers and freight to and from European Russia. Almost all of Siberia's resources are used in European Russia, where most of the nation's people live. The railroad transports Siberian coal and other minerals, and pipelines carry the region's oil and natural gas. The major rivers of Siberia flow into the ice-bound Arctic Ocean, where icebreakers keep shipping lanes open for only a few months in summer. Airlines link Siberian cities with those in European Russia.

A network of radio stations and a television communications satellite serve all Siberia. Telegraph lines connect the major areas of the region.



Howard Sochurek, Woodfin Camp, Inc.

Furs from Siberian Animals, including the snow-white ermine, are sent by trappers to a warehouse in Irkutsk, above. The warehouse ships the pelts to Leningrad, where fur dealers from many parts of the world buy them.

History

People lived in Siberia more than $2\frac{1}{2}$ million years ago. A Mongol group called Tartars, under the emperor Genghis Khan, conquered the southern steppes during the early 1200's. They drove many of the original tribes into the northern forests. In the late 1500's, a band of Russian Cossacks, led by an adventurer named Yermak, defeated the Tartars. Russian fur traders reached the Pacific coast about 1630. By 1700, the Russians controlled almost all Siberia.

During the early 1900's, Russia began to build industries in Siberia. The government moved hundreds of factories and thousands of workers from European Russia to Siberia during World War II (1939-1945). This action protected the factories from the German armies that invaded Russia from the west.

In the mid-1900's, scientists discovered large deposits of coal, oil, and other resources in Siberia. Russia and Japan signed an agreement in 1974 to develop a coal mine in eastern Siberia for the Japanese steel industry. That same year, construction began on a 2,000-mile (3,219-kilometer) railroad called the Baykal-Amur Mainline. Completion of this railroad, running between Lake Baykal and Komsomolsk, was scheduled for 1983.

THEODORE SHABAD

Related Articles in WORLD BOOK include:

CITIES

Irkutsk, Novosibirsk, Omsk, Sverdlovsk, Vladivostok

PHYSICAL FEATURES

Amur River, Irtysh River, Kamchatka Peninsula, Lake Baykal, Lena River, Ob River, Sakhalin, Stanovoy Mountains, Ural Mountains, Yablonovyy Mountains, Yenisey River

OTHER RELATED ARTICLES

Arctic, Eskimo, Permafrost, Russia, Trans-Siberian Railroad

SIBERIAN HUSKY is an Arctic sled dog. It is related to the Alaskan malamute, the Eskimo dog, and the Samoyed. Some authorities believe it originated in Siberia. A graceful, quick dog, the husky is also alert and strong. It has a thick, soft, double coat, with a smooth outer coat and a downy under coat. It is usually colored some shade of gray, often with white markings. The husky stands about 23 inches (58 centimeters) high, and weighs 35 to 60 pounds (16 to 27 kilograms). See also Dog (color picture: Working Dogs). Olga Dakan

SIBLEY, HENRY HASTINGS. See Minnesota (Places to Visit; History).

SIBYL, *SIHB uhl,* was the name ancient Romans gave to any aged woman who could supposedly foretell the future. The best known was the Cumaean Sibyl. According to legend, the god Apollo promised that she would live one year for each grain of sand she could hold in her hands. But Apollo did not give her eternal youth, and she continued to age. Her shrunken body was eventually kept in a bottle. Sibyl guided Aeneas, the Trojan warrior, to the lower world to learn the future of Rome. Later, she offered to sell nine books of prophecy, called the Sibylline Books, for a high price to a king of Rome. When the king refused twice, Sibyl burned three books each time. The king finally paid the original price for only three. These books of prophecy were consulted in times of danger until they were destroyed by fire in 83 B.C. Herbert M. Howe

SICILIES, *SIHS uh leez,* **KINGDOM OF THE TWO,** was the name of an early kingdom of Italy. It consisted of the Kingdom of Naples in southern Italy, and the Kingdom of Sicily on the island of Sicily. At times, they were united as the *Two Sicilies* (see Italy [map: Italy—Late 1800's]). The kingdom was formed in the early 1100's by Normans, who conquered the region during the 1000's. See Middle Ages (map: Feudal States of Europe).

In 1266, the Two Sicilies came under French rule. In 1282, an uprising known as the Sicilian Vespers took place in Sicily. It resulted in the massacre of nearly all the French on the island. Sicily was later separated from Naples and ruled by the Spanish. In the War of the Spanish Succession in 1713, Austria seized Naples, and Sicily was given to Savoy. Savoy turned Sicily over to Austria in 1719, in exchange for Sardinia.

In 1734, Spain conquered the Two Sicilies, and the Spanish Bourbon family ruled them until the time of Napoleon. King Ferdinand I joined the allies against France and lost Naples as a result. The two parts of the kingdom were reunited after Napoleon's downfall.

The Kingdom of the Two Sicilies played an important part in the movement for a united Italy. In 1820, there was an uprising in Naples of the Carbonari, a secret nationalist society. King Ferdinand was forced to grant the Neapolitans a constitution. An Austrian army invaded Naples, and restored Ferdinand to power.

In 1860, Giuseppe Garibaldi landed at Marsala, on the Sicilian coast, and conquered all Sicily. Garibaldi then invaded the mainland and marched on Naples. King Francis II fled, leaving the kingdom in the hands of the patriots. In a plebiscite, the people approved the unification of Italy. In 1860, the Kingdom of the Two Sicilies became part of the domain of Victor Emmanuel, who became King of Italy in 1861. J. Salwyn Schapiro

SICILY (pop. 4,726,091) is an Italian island in the central Mediterranean Sea. The Strait of Messina separates Sicily from the mainland of Italy. For Sicily's location, see Italy (political map). Sicily covers 9,926 square miles (25,708 square kilometers) and is the largest island in the Mediterranean.

Sicily is one of Italy's 20 governmental units called *regions.* Palermo, a center of industry and trade, is the capital, largest city, and chief seaport of Sicily. Messina, on the northeastern coast, serves as a gateway to the island. Workers commute daily by ferry across the strait between Messina and the Italian mainland.

The People. Sicily's location long made it a crossroads for many civilizations. A number of peoples invaded the island, including Greeks, Carthaginians, Romans, and *Saracens* (Moslems from North Africa). Today, Sicily has a mixture of these civilizations. For example, the people speak local *dialects* (forms of speech) that have traces of Arabic, Greek, and other languages.

The people of Sicily have strong bonds of family and friendship. Some Sicilians, because of many years of foreign rule, distrust all forms of government. They have a code of honor, called *omertà,* that forbids telling the police about crimes considered to be private affairs. A serious problem in Sicily is the widespread power of the Mafia, an illegal secret organization with roots deep in Sicilian life. The Mafia has committed many crimes. But the people's fear of the Mafia—and their sense of omertà—has largely blocked government efforts to fight the organization. See Mafia.

Most Sicilians are farmers who barely manage to make a living because of poor land and outdated farming methods. A lack of jobs in Sicily is one of the chief reasons for a high rate of emigration. During the early 1900's, thousands of Sicilians moved to the United States. Since 1945, large numbers of Sicilian workers have settled in the industrial cities of northern Italy, France, Germany, and Switzerland. About 500,000 Sicilians left the island during the 1960's.

Most of Sicily's people are Roman Catholics. They hold colorful religious festivals throughout the year.

Many famous landmarks attract tourists to Sicily. Greek ruins stand at Agrigento, Syracuse, Taormina, and other places in Sicily. Many Sicilian cathedrals and palaces exhibit works of art. Educational institutions include universities in Catania, Messina, and Palermo.

Land and Climate. Mountains and hills cover more than 85 per cent of Sicily. Its highest point is Mount Etna, a volcano that rises 10,902 feet (3,323 meters) on the east coast (see Mount Etna). It erupts periodically, but this area is heavily populated because volcanic ash makes the soil fertile. Earthquakes also hit Sicily.

Sicily has a mild climate. Temperatures average 45° F. (7° C) in winter and 79° F. (26° C) in summer. The island gets most of its rain during the winter. Little rain falls from March to October, and the air becomes even drier because of a hot, dry wind called the *sirocco.* This wind blows across the Mediterranean Sea from the deserts of North Africa. Sicilian rivers dry up in summer, and the land becomes parched in unirrigated areas.

Sicily was once heavily wooded, but most of the trees have been cut, leaving the mountainsides bare and easily eroded. Farmers use much of the island for grow-

Toni Schneiders, Bruce Coleman, Inc.

The Town of Taormina, Sicily, lies among the hills near Mount Etna, a snow-capped volcano, *background.* Hills and mountains cover most of Sicily, and Mount Etna is the highest peak on the island.

ing grain and for grazing goats and sheep. Along the coasts, irrigation provides water for such crops as almonds, grapes, lemons, olives, oranges, and potatoes.

Economy. Sicily has prospered many times in its long history. But since the 1400's, the island's economy has become underdeveloped. Most of the land was divided into large estates owned by a few persons. Farmers used outdated methods and made little effort to prevent soil erosion. The island had few industries to provide jobs.

Since the 1950's, Sicily's economy has started to improve. A government land reform program broke up some of the large estates, and small farmers received plots of their own. The government planted trees to prevent erosion, expanded irrigation projects, and built dams to collect winter rainfall for use in summer.

Several industries developed in Sicily during the 1900's. Part of this development resulted from the discovery of oil at Ragusa in 1954 and later at Gela. A pipeline opened in 1957 and linked the Ragusa oil field to a large new refinery in the port city of Augusta. The refinery also uses large quantities of oil imported from the Middle East. Factories in several coastal cities refine sulfur and make fertilizer from potash. The island produces much of Italy's asphalt and salt. Sardine and tuna fishing also are important.

Government. In 1948, Sicily became a semi-independent political region of Italy. The island has nine provinces and a 90-member parliament. It also sends representatives to the federal government in Rome.

History. Discoveries of cave drawings and tools show that prehistoric men lived in what is now Sicily. During the 700's B.C., the Greeks colonized the eastern part of the island, and the Carthaginians founded trade settlements in the western part. The Romans conquered Sicily in the 200's B.C. and made it their first province. Sicily grew grain for the Roman Empire.

After Rome declined during the A.D. 400's, the Vandals and the Ostrogoths conquered Sicily. In 535, the island came under the control of the Byzantine Empire. Greek became the official language of the island's people. The Saracens replaced the Byzantine rulers in the 800's. Sicily flourished during about 200 years of Moslem rule. The Saracens introduced irrigation and such crops as cotton, lemons, and oranges. Moslem art, literature, and science influenced the Sicilians.

During the 1000's, the Normans conquered Sicily. They joined Sicily with southern Italy and formed the Kingdom of the Two Sicilies. Under the Normans, the island's culture gradually became Western European. In the 1200's, German—and, later, French—rule added to the mixture of traditions in Sicily. During this period, Sicily became the cultural center of Italy. In 1282, an uprising called the *Sicilian Vespers* ended French rule.

During the next 400 years, Sicily was ruled by Spain, Savoy, and Austria. In the 1700's, Sicily became part of the Bourbon Kingdom of the Two Sicilies. After the Italian patriot Giuseppe Garibaldi invaded Sicily in 1860, the island revolted against Bourbon rule. Sicily then became part of the Kingdom of Italy.

During World War II (1939-1945), the Allies heavily bombed Sicily's air and naval bases. Allied troops landed on the southeastern coast of the island on July 10, 1943. The Allies occupied all of Sicily after the fall of Messina on August 17. The island then became the springboard for the Allied invasion of Italy.

After the war, the Italian government built about 40 towns in Sicily for farmers who were to receive plots under the land reform program. But this program was not so successful as the government had hoped it would be, and the towns still stood empty in the 1970's.

During the 1950's, a road construction program began on the island. Sicily's first superhighway, linking Catania and Messina, opened in 1971. Also in 1971, the government approved a plan to build a bridge connecting Messina with southern Italy. EMILIANA P. NOETHER

Related Articles in WORLD BOOK include:

Catania
Garibaldi, Giuseppe
Italy
Messina
Messina, Strait of
Palermo
Sicilies, Kingdom of the Two
Syracuse

SICK MAN OF EUROPE. See TURKEY (History).

SICKLE. See KNIFE (picture); SCYTHE.

SICKLE CELL ANEMIA is a hereditary blood disease that occurs chiefly among Negroes. It causes attacks that include severe pain, high fever, and damage to body tissues. Sickle cell anemia may injure almost all parts of the body, especially the bones, the central nervous system, the liver, the lungs, and the spleen. Some victims suffer blindness, convulsions, paralysis, or loss of speech. Many die in childhood, and few live past the age of 40.

Sickle cell anemia occurs if a person's red blood cells contain too many *hemoglobin* molecules of an abnormal type. Hemoglobin gives the red blood cells their color and carries oxygen to the body tissues. Too much of the abnormal hemoglobin, called *hemoglobin S*, causes the cells to *sickle* (change to a sickle shape). This occurs if the amount of oxygen in the blood drops too low.

Sickled cells clog blood vessels and interfere with the flow of blood. This interference deprives the body tissues of oxygen and causes a painful attack called a *crisis*. A sickle cell crisis may last several days.

Many Negroes are born with some hemoglobin S in their blood. A small amount—inherited from only one parent—does little harm. A large amount—inherited from both parents—produces sickle cell anemia in almost all cases.

Until 1970, physicians knew no way to prevent attacks of sickle cell anemia. That year, a team of United States doctors discovered that *urea*, a chemical compound, reverses the sickling process. Some physicians believe that daily doses of urea will provide significant relief from sickle cell anemia. But urea can also cause excessive loss of fluids through the urine. Researchers are experimenting with methods of safely adding urea to the blood. ROBERT M. NALBANDIAN

See also RACES OF MAN (Race and Disease; picture: Sickle Cell Anemia); CELL (Metabolic Diseases).

SIDDHARTHA GAUTAMA. See BUDDHA.

SIDDONS, *SID'nz,* **SARAH KEMBLE** (1755-1831), was a British actress who enchanted audiences and critics with her rich voice, striking beauty, and powerful presence. She became a subject of poets and painters.

Sarah Siddons was born in Brecon (now Brecknock), Wales. She acted in her father's touring company, and married actor William Siddons when she was 18. In 1775 and 1776, she failed as an actress in David Garrick's Drury Lane Theatre in London. She gained more experience, rejoined Garrick's company in 1782, and succeeded. Her great roles include the Shakespearean heroines Lady Macbeth, Desdemona, and Ophelia. She retired in 1819. MARSTON BALCH

See also SHAKESPEARE, WILLIAM (The Age of Garrick).

SIDEREAL TIME, *sye DEER ee ul,* measures the rotation of the earth in relation to the stars. *Solar time,* which we use to tell time in our daily lives, measures the earth's rotation in relation to the sun. Astronomers use sidereal time because the same stars are always in the same place in the sky at the same sidereal time from day to day. The same stars are not in the same place at the same solar time each night.

A sidereal day consists of 24 sidereal hours. It is the time the earth takes to rotate once on its axis past an imaginary line from the earth's center to any star. Astronomers measure sidereal time from a point in the sky called the *vernal equinox*. But no bright star marks this point (see TIME [Measuring Time by the Stars]).

When astronomers measure a solar day, they use an imaginary line to the sun. But by the time the earth has rotated once in relation to an imaginary line to a star, it has moved westward along its orbit. The sun is then about one degree east of its position at the start of the earth's rotation. The earth needs additional time to rotate eastward to bring it back to the imaginary line to the sun. As a result, a *mean* (average) solar day is 3 minutes 56.55536 seconds of mean sidereal time longer than a sidereal day. A sidereal day equals 23 hours 56 minutes 4.09054 seconds of mean solar time. ERIC D. CARLSON

See also MOON (The Orbit of the Moon).

SIDERITE. See IRON AND STEEL (Kinds of Iron Ore).

SIDESADDLE FLOWER. See PITCHER PLANT.

SIDING. See HOUSE (House-Building Terms).

SIDJAKOV, *SID jah kahv,* **NICOLAS** (1924-), is a Latvian-born artist and illustrator. He won the Caldecott medal in 1961 for illustrating *Baboushka and the Three Kings*, a Russian Christmas folk tale adapted by Ruth Robbins. He also illustrated *The Friendly Beasts* (1957) by Laura N. Baker. Sidjakov was born in Riga, Latvia. He studied painting at the École des Beaux Arts in Paris. He came to the United States in 1952 and became a leading commercial artist. ELOISE RUE

SIDNEY, ALGERNON. See RYE HOUSE PLOT.

SIDNEY, SIR PHILIP (1554-1586), was an author, courtier, and soldier during the reign of Queen Elizabeth I of England. He became famous for his literary criticism, prose fiction, and poetry.

Sidney was born in Penshurst in Kent. He traveled widely and was popular at court. In *The Defense of Poesy* (1580?), Sidney championed the poet as more important than the philosopher or the historian. This was the first major literary criticism in English.

Sidney opposed Queen Elizabeth's proposed marriage to the Duke of Anjou in 1580. He went into temporary retirement at Wilton, home of his sister Mary, Countess of Pembroke. For her amusement, he wrote a romantic prose and verse narrative *Arcadia*. Sidney later made major revisions, but the work was edited in its final form by the countess.

Sidney's greatest work is *Astrophel and Stella*—108 sonnets and 11 songs. This sequence—written in the early 1580's out of his unreturned love for Penelope Devereux—is one of the world's great love poems.

Sidney ended his retirement in 1583. In 1585, he became governor of Flushing in The Netherlands. He died of a wound in a battle there in 1586. THOMAS A. ERHARD

SIDON, *SY d'n,* was an important manufacturing and port city in ancient Phoenicia. The present-day town of Sayda, Lebanon, occupies its site. Sidon was most famous for its purple dye and blown-glass industries. The Greek poet Homer mentioned silver bowls of Sidon. Sidon was usually overshadowed in importance by the nearby Phoenician city of Tyre (now Sur, Lebanon), its chief commercial rival. But Sidon enjoyed a brief period of supremacy and independent prosperity after Babylonia defeated Tyre in 573 B.C. LOUIS L. ORLIN

SIECUS. See CALDERONE, MARY STEICHEN.

SIEGBAHN, *SEEG bahn,* **KARL MANNE GEORG** (1886-), a Swedish physicist, became noted for his work with X rays and X-ray spectroscopy. He turned from an early interest in electricity and magnetism to the study of X rays in 1914. To overcome difficulties in this field of research, he developed new types of X-ray spectrographs, and improved X-ray tubes. With this more accurate equipment, he could make more precise measurements than had previously been possible, and he investigated the internal structure of atoms through the study of their X-ray spectra. He received the 1924 Nobel prize in physics. Siegbahn was born in Örebro, Sweden, and studied in Sweden and Germany. In 1937, he became director of the Nobel Institute for Physics at the Stockholm Academy of Sciences. G. GAMOW

SIEGE, *seej*, takes place when a military force surrounds a defended position to capture it by assaults or by starving it into surrender. The word *siege* comes from the Latin *sedere, to sit.* HUGH M. COLE

Related Articles in WORLD BOOK include:

Army	Roman Empire (picture: The Roman Army [When Besieging City Walls])
Battering Ram	
Catapult	
Civil War	Russo-Japanese War
Crimean War	Sepoy Rebellion
Franco-Prussian War	Troy, or Ilium
Gibraltar	World War I
Hundred Years' War	World War II

SIEGE PERILOUS. See ROUND TABLE.

SIEGFRIED, *SEEG freed*, is the hero of several German legends. We know his story best from the music-dramas of Richard Wagner. Siegfried is the hero of two of these, *Siegfried* and *Die Götterdämmerung*. In Wagner's operas, Siegfried forges a great sword from the broken one of his father, Siegmund. He kills a dragon with this powerful weapon. He then wins the magic ring and the cloak of Tarnhelm. This makes him unbeatable in battle. He frees Brünnhilde, the Valkyrie daughter of Wotan, from enchantment, and they fall in love. Siegfried is cast into a spell by the plotting of Hagen, and aids Gunther in marrying Brünnhilde. Siegfried marries Gutrune (Gudrun), Gunther's beautiful sister, while still under the spell. Siegfried is killed by Hagen while he is off guard after coming out of the enchantment. EINAR HAUGEN

See also NIBELUNGENLIED; OPERA; SIGURD.

SIEGFRIED LINE was the name of two separate fortified lines of defense established by Germany in the 1900's. German generals Paul von Hindenburg and Erich von Ludendorff had the first Siegfried Line built in the winter of 1916-1917, during World War I (1914-1918). The line stretched across northern France and Belgium. The Allies, who called the barrier the *Hindenburg Line*, smashed the line near the end of the war.

During the 1930's, Nazi dictator Adolf Hitler built a new Siegfried Line along the border between Germany and France. This chain of steel forts and concrete tank barriers stood opposite the Maginot Line, a similar fortification built by France (see MAGINOT LINE). The Allies broke through Hitler's Siegfried Line during World War II (1939-1945). Parts of this line still stand. THEODORE ROPP

See also WORLD WAR I (The Last Campaigns; map: The Western Front in World War I).

SIEMENS, *ZEE munz*, is the family name of two brothers from Germany who were inventors and industrialists.

Werner von Siemens (1816-1892) built telegraph lines in Germany, Russia, and other European countries. With his brother, he developed electric railways and lighting, and helped lay the early deep-sea telegraphic cables. While in the Prussian army's engineering service, Siemens developed an improved electroplating process. Later, he invented a dynamo that his brother used to run railways. Ernst Werner von Siemens was born in Lenthe near Hannover, Germany.

Wilhelm Siemens (1823-1883) invented a regenerative gas-fired furnace in 1856 that led to the open-hearth steelmaking process. He took his brother's electroplating process to England to sell in 1843, and settled there. He was knighted as Sir Charles William in 1883. Siemens was born in Lenthe. JOHN B. MCFERRIN

SIENA, *see EN uh* (pop. 61,453), lies in the hills of Tuscany near Florence, Italy (see ITALY [political map]). Its central square, the Piazza del Campo, is internationally famous. The City Hall overlooks it. Horses sponsored by districts in the city run races known as the *Palio* in this square each year.

Siena's Gothic cathedral is made of black and white marble, and is one of Europe's most famous medieval cathedrals. Siena has a university that dates from the 1200's. The city is the home of Saint Catherine, the patron saint of Italy. SHEPARD B. CLOUGH

See also CITY (picture).

SIENA COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SIENA HEIGHTS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SIENKIEWICZ, *shen KYEH veech*, **HENRYK** (1846-1916) was a popular Polish novelist. He won the Nobel prize for literature in 1905. His most celebrated novel is *Quo Vadis?* (Whither Goest Thou?, 1895). A story of Roman society under Nero, it was dramatized and made into motion pictures in a number of countries.

The novel *With Fire and Sword* (1890) was also popular. This book is the first part of a *trilogy* (three-part work) that describes society in Poland during the wars of the 1600's against the Cossacks, Turks, and Swedes.

Sienkiewicz was born in Siedlce, Russian Poland. He became a leader of patriots working for Polish independence. ERNEST J. SIMMONS

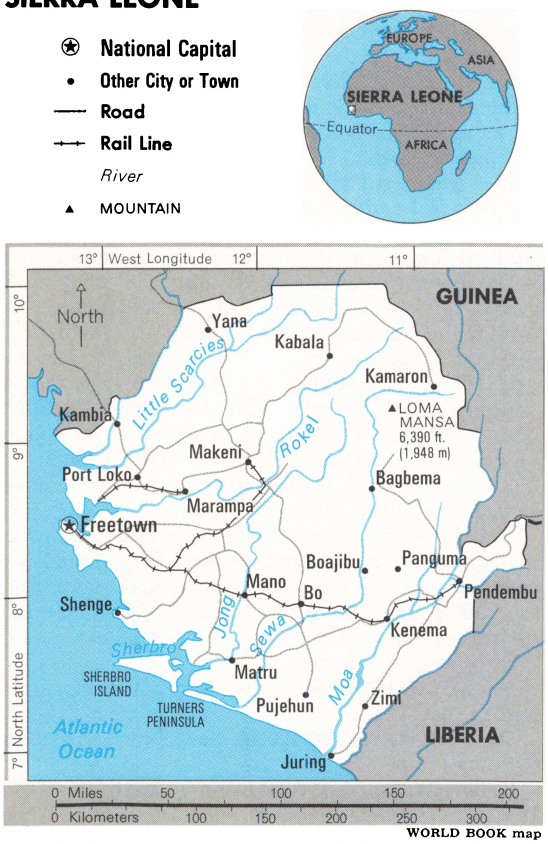
SIERRA CLUB is an American organization that works to protect the environment. It also provides opportunities for its members to explore and enjoy the forests, parks, and wilderness areas of the United States.

The Sierra Club has about 140,000 members in all 50 states. Local groups organize conferences and lectures, films and exhibits, mountain-climbing and skiing expeditions, and trips into the wilderness. The club has hundreds of committees that strive to save threatened natural resources, scenic areas, and wildlife. The Sierra Club publishes a weekly news report, a monthly magazine, special newsletters, and books.

The club was founded in 1892 in San Francisco by the naturalist John Muir. Muir, who wanted to preserve the natural beauty of the Sierra Nevada Mountains in eastern California, became the group's first president. The club has headquarters at 1050 Mills Tower, San Francisco, Calif. 94104. WILBUR R. JACOBS

See also MUIR, JOHN.

SIERRA LEONE



WORLD BOOK map

SIERRA LEONE, *sih AIR uh lee OHN*, is a small country on Africa's western "bulge," north of the equator. It is slightly smaller than the state of South Carolina, and has about as many people as that state.

Sierra Leone provides a large portion of one of the world's most valuable treasures—diamonds. It ranks as the world's third largest producer of gem stones and the sixth largest producer of industrial diamonds. The country's diamonds lie in gravel deposits along riverbeds and in swamps in eastern parts of the country. About half of the diamonds make gemstones, and the rest are less expensive industrial diamonds.

Sierra Leone, a former British colonial possession, became independent in 1961. It remained a member of the Commonwealth of Nations. Freetown is the country's capital, only large town, and main port. The city was founded in 1787 as a settlement for freed slaves.

Government. Sierra Leone is a republic. The president serves as head of the government. He is elected to a five-year term by the House of Representatives, Sierra Leone's lawmaking body. The people elect 84 members of the House of Representatives. The House also has 12 members who are tribal chiefs elected by representatives of local councils. All members of the house serve five-year terms.

W. E. F. Ward, the contributor of this article, is the author of several books on Africa, and former Deputy Educational Advisor in the British Colonial Office.

People. Sierra Leone has a population of 2,788,000. Most of the men are farmers. But many grow only enough food for their families, and work during the dry season mining diamonds. Many of the women run profitable businesses selling goods in local markets. Freetown has many modern buildings (see FREETOWN). Many people in villages live in concrete block houses, and many poor people in rural areas live in houses made of mud with corrugated iron or thatched roofs.

Most of Sierra Leone's people are Africans who form 12 main tribes. About a third of the people belong to the Mende tribe. They live in the southern part of the country. About a fourth of the people belong to the Temne tribe, and live in western Sierra Leone. About 130,000 *Creoles* (descendants of freed slaves) live in or near Freetown. English is the official language, but most of the people speak tribal languages. The Creoles speak *Krio*, a local form of English.

Most of the people practice local religions. For example, Mende tribesmen believe *Ngewo* (God) created the world and everything in it. They worship small human images called *nomoli*, which they find in the soil. No one knows who made the figures. The Mende believe Ngewo made them. Some of the people practice Christianity and Islam. The Creoles are Christians.

Education is developing rapidly. Illiteracy, once widespread, is disappearing. More than 165,000 boys and girls attend more than 1,100 elementary schools, and about 34,000 attend about 100 secondary schools. About 2,000 students receive higher education. Sierra Leone also has two university colleges.

Land. The country covers an area of 27,699 square miles (71,740 square kilometers). Freetown lies at the end of the Sierra Leone Peninsula. The Sierra Leone mountains rise to about 3,000 feet (910 meters) above sea level there. Swamps cover most of the coastal region, and extend about 20 miles (32 kilometers) inland.

Inland from the coastal swamps, a coastal plain extends as far as 100 miles (160 kilometers) in the northern part of the country. This plain slopes up to a region of plateaus and mountains in the northeast that covers about half of the country. The mountains rise to more than 6,000 feet (1,800 meters) near the eastern border with Guinea. Loma Mansa, 6,390 feet (1,948 meters), is the country's highest point. Gravel or sandy soil, on

FACTS IN BRIEF

Capital: Freetown.

Official Language: English.

Form of Government: Republic.

Area: 27,699 sq. mi. (71,740 km²). *Greatest Distances*—north-south, 220 mi. (354 km); east-west, 190 mi. (306 km). *Coastline*—210 mi. (338 km).

Population: *Estimated 1976 Population*—2,788,000; distribution, 85 per cent rural, 15 per cent urban; density, 101 persons per sq. mi. (39 persons per km²). *1963 Census*—2,289,373. *Estimated 1981 Population*—3,004,000.

Chief Products: *Agriculture*—bananas, cassava, cattle, cocoa, coffee, ginger, millet, palm products, peanuts, piassava, rice, sorghum. *Fishing*—tuna. *Mining*—chrome ore, diamonds, iron ore, rutile.

Flag: Three horizontal stripes—green, white, and blue. See FLAG (color picture: Flags of Africa).

Money: *Basic Unit*—leone. See MONEY (table: Values).

which only short grass grows, covers more than half the country. The government is clearing coastal mangrove swamps to convert them into rice fields. It has also planted new forests.

Sierra Leone has a rainy, tropical climate. The dry season lasts through January and February in the south, and from December through March in the north. Freetown receives about 144 inches (366 centimeters) of rainfall a year, and some high places receive more. Only a narrow strip in the north has less than 80 inches (200 centimeters) a year. Temperatures average from 77° to 81° F. (25° to 27° C) except in the extreme north, where greater variation occurs.

Economy. Farmers of Sierra Leone produce a wide variety of crops. But poor soil, the dry season, and the use of traditional farming methods keep crop yields low. Little effort is made to keep the soil fertile. As soon as the soil wears out on one plot, a farmer moves to a new area, clears the land, and plants a food crop.

Rice is the main food crop. Palm kernels are the chief export crop. The country is the world's leading exporter of *piassava*, a fiber from the raffia palm used in making brushes (see RAFFIA). There is also some tuna fishing off the coast near Freetown.

Diamonds make up about two-thirds of the total value of Sierra Leone's exports. Diamonds are mined by a British company, Sierra Leone Selection Trust, Ltd., and by over 3,000 licensed Sierra Leone diggers. The British firm can work in only a small part of the field, an area of about 310 square miles (803 square kilometers). The diggers can work in areas covering about 9,500 square miles (24,600 square kilometers). The government controls the quantities of diamonds mined, but many persons mine diamonds illegally and smuggle them out of the country. The government made an agreement with a U.S. company in 1965 to establish a diamond-cutting industry in Sierra Leone.

Diamonds were discovered in 1930. Since then, deposits of iron ore, bauxite, and rutile have been discovered. Bauxite is used in making aluminum, and rutile contains the important metal titanium. Iron ore is the second most important export from Sierra Leone.

Sierra Leone has 358 miles (576 kilometers) of railroads. One line links the seacoast with iron ore deposits at Marampa. Another connects Freetown with Makeni and Pendembu. There are about 3,000 miles (4,800 kilometers) of roads. About 500 miles (800 kilometers) of rivers are navigable by small craft for three months each year. Freetown has an international airport.

History. Historians know little about Sierra Leone before 1460, when Portuguese seamen visited the area. In the 1500's, European trading ships began stopping there. The Europeans shipped many of the people from this area to America as slaves.

About 1725, Fulani people who lived east of present-day Sierra Leone began a holy war to convert their neighbors to the Islamic religion. As the Fulani moved westward, many other peoples also migrated toward the coast and settled in what is now Sierra Leone.

In 1787, Granville Sharp, an Englishman opposed to slavery, settled about 400 freed American Negro slaves on land where Freetown now stands. The settlers suffered from hunger, disease, and warfare, and the settlement almost died out. Great Britain made the slave trade illegal in 1807. The next year, the British government made the Sierra Leone Peninsula a colony. The British freed slaves from the slave ships of many nations, and settled them in the colony. British influence gradually spread inland. In 1896, the British established a protectorate over an area that, with the colony, had almost the same borders as present-day Sierra Leone.

Between 1896 and 1961, Sierra Leone moved gradually toward self-government. In 1961, it became completely independent, but reminded a member of the Commonwealth of Nations. Sir Milton Margai, the first prime minister, died in 1964. His brother, Sir Albert Margai, succeeded him. Political leaders struggled for power after indecisive parliamentary elections in 1967. Army officers then took over the government, dissolved the legislature, and suspended the Constitution. In

Paul S. Conklin

Freetown is Sierra Leone's capital and trade center. The city was founded in 1787 as a home for freed slaves.

1968, the military government was overthrown. Siaka Stevens became prime minister and head of a new civilian government. In 1971, the legislature rewrote the Constitution and made Sierra Leone a republic, with Stevens as president. W. E. F. WARD

SIERRA MADRE, *MAD ray,* a name often used for mountain ranges, is Spanish for *Mother Range.* Sierra Madre is the name of mountain ranges in Spain, Mexico, and on Luzon Island in the Philippines. The Sierra Madre mountains in Mexico form the edge of a wide central plateau.

The Sierra Madre Oriental (east) lies on the east side of the plateau, toward the Gulf of Mexico. The Sierra Madre Occidental (west) borders the plateau on the west. Canyons and deep deposits of volcanic material make it difficult to cross. Part of the Sierra Madre Occidental extends north into Arizona and New Mexico. The range is 2,000 miles (3,200 kilometers) long and over 100 miles (160 kilometers) wide. MARGUERITE UTTLEY

See also MEXICO (physical map).

SIERRA NEVADA. See SPAIN (The Meseta).

SIERRA NEVADA is a huge uplifted and tilted granite mountain range which extends north and south for 400 miles (640 kilometers) in eastern California. Its highest point is Mount Whitney (14,495 feet, or 4,418 meters). The Sierra Nevada is about 70 miles (110 kilometers) wide. It covers 31,000 square miles (80,300 square kilometers) between the Great Basin and the Central Valley of California. See also CALIFORNIA (Land Regions; map); LAKE TAHOE; SEQUOIA NATIONAL PARK; YOSEMITE NATIONAL PARK. JOHN H. GARLAND

SIESTA. See LATIN AMERICA (Customs).

SIEVE OF ERATOSTHENES is a method developed by the Greek mathematician Eratosthenes for identifying *prime numbers.* These are numbers other than 1 that can only be divided evenly by 1 and themselves. Today, electronic computers can be used to identify prime numbers, but the system still resembles the method used by Eratosthenes.

The first step in finding prime numbers with a sieve of Eratosthenes is to write a series of whole numbers, beginning with the number 2. Next, counting from 2, underline every second number to mark it off. You can imagine that the numbers not underlined have passed through a wire sieve. This eliminates numbers that can be divided evenly by 2, except for 2 itself.

Starting again with 3, the next number after 2 not underlined, cross off every third number. Count numbers which have not passed through the sieve as well as those which have. This eliminates numbers that can be divided evenly by 3, except for 3 itself. By continuing this process with the next larger unmarked number, only prime numbers remain.

The beginning of a sieve of Eratosthenes is shown below. It shows that 2, 3, and 5 are the first three prime numbers.

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 . . .

In the next step, start with 5 and cross off every fifth number. The process is endless, because there is no last prime number. PHILLIP S. JONES

SIEVE TUBE. See BARK.

SIEYÈS, *syay YES,* **EMMANUEL JOSEPH** (1748-1836), popularly known as ABBÉ SIEYÈS helped start the French Revolution with his booklet, *What Is the Third Estate?* In this booklet, published in 1789, Sieyès insisted that the people should have a voice in government.

Born in Fréjus, France, Sieyès became a priest. He was elected to the Estates-General in 1789 and served as president of the Assembly in 1790. Sieyès was a moderate and an expert on constitutions. He was a member of the Convention during the Reign of Terror. Robespierre called him the *cunning fox* for his silent opposition to the Jacobins.

Sieyès served as ambassador to Berlin in 1798, and a year later joined the French executive, the Directory. From 1815 to 1830, Sieyès was exiled by the restored Bourbon kings. RAYMOND O. ROCKWOOD

SIF. See THOR.

SIFTON is the family name of two Canadian political leaders who were brothers. Both were born in Middlesex County, Upper Canada (now Ontario).

Arthur Lewis Sifton (1858-1921) served as chief justice of the supreme court of the Northwest Territories from 1903 to 1905, and of Alberta from 1905 to 1910. As leader of the Liberal Party, he was premier of Alberta from 1910 until 1917. In 1917, he entered the Canadian federal government as minister of customs.

Sifton served as a Canadian delegate to the peace conference at Versailles in 1919 following World War I. He was secretary of state from 1920 until his death.

Sir Clifford Sifton (1861-1929) served as Canadian minister of the interior from 1896 to 1905. He played a leading part in settling western Canada by launching a vigorous immigration campaign in Great Britain and continental Europe. He served as chairman of the Canadian Conservation Commission from 1909 until 1918.

SIGH, *sy,* is a single long breath. It may be a long inhalation followed by a long exhalation. It may also be a long inhalation followed by a hard short exhalation. The sigh may vibrate the vocal cords and sound the voice. No one really knows why people sigh or what it does for the body. A person may sigh from boredom, weariness, or in times of extreme pleasure or stress. A sigh might be thought of as expressing something for which no words can be found. GORDON FARRELL

SIGHT. See EYE.

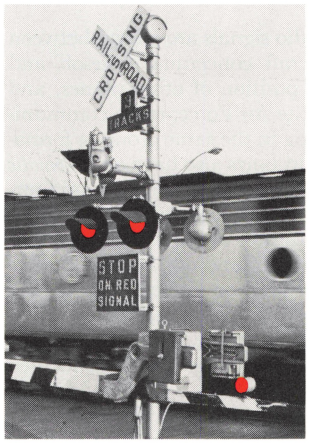
SIGHT BILL. See BILL OF EXCHANGE; DRAFT.

SIGILLARIA. See SATURNALIA.

SIGISMUND, *SIJ is mund* (1368-1437), was a Holy Roman emperor and a king of Bohemia and Hungary. His chief concern was to end the Great Schism which split the Roman Catholic Church. In 1414, he forced John XXIII (an antipope) to call the Council of Constance, which resulted in the election of Martin V as pope. The council also ended the schism and burned the religious leader John Huss. Following the council's action, the Hussites rose in a rebellion which Sigismund could not crush. See also POPE (The Troubles of the Papacy); HUSS, JOHN. ROBERT G. L. WAITE

SIGMA 7. See SPACE TRAVEL (table: Manned Space Flights); SCHIRRA, WALTER M., JR.

SIGMA XI, *SIG muh ZI,* is an honorary scientific society. It was founded at Cornell University in 1886 to encourage study in the pure and applied sciences. Members include men and women who have done important scientific work. University students who are qualified



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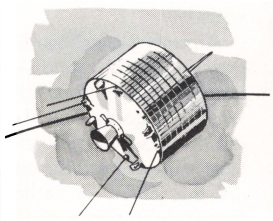
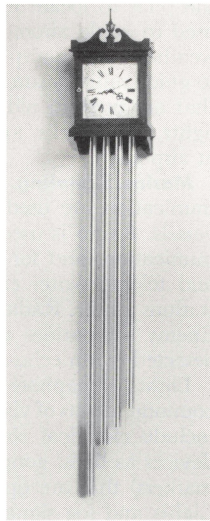
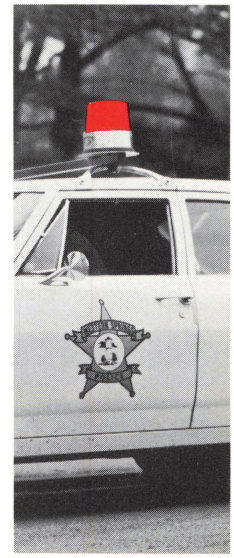


Emerson-Rittenhouse



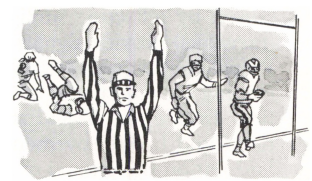
Hedrich-Blessing

Jet Propulsion Laboratory



WORLD BOOK photo

Signals are used in many ways to send various types of information. Some signals are warnings of danger, some are used to transmit messages long distances, and others are used to explain actions when voice communication is impossible.



may be elected to associate membership in the society.

Sigma Xi has about 175 chapters and 230 local clubs in the United States. There are about 130,000 members who are actively associated with the society. Sigma Xi publishes a magazine called *American Scientist*. Another publication, *Science in Progress*, contains articles by leading scientists who are members of Sigma Xi. The society has headquarters at 345 Whitney Avenue, New Haven, Conn. 06511. Critically reviewed by SIGMA XI

SIGN, ELECTRIC. See ELECTRIC SIGN.

SIGN LANGUAGE is a system of hand signs and gestures that persons may use in order to communicate. Primitive men talked in sign language. Early monks who took vows of silence used sign language. Some South American Indians use sign language to communicate with tribes who speak a different language.

The Abbe de l'Epee, who founded the first school for the deaf in Paris about 1760, used sign language and finger spelling to teach the deaf. Deaf persons use as many as 1,500 signs as well as finger spelling. In finger spelling, a person places his fingers in certain positions to indicate each letter (see DEAFNESS).

Sign language is also used in sports. For pictures of some of the signals used in sports, see BASKETBALL; CRICKET; FOOTBALL. EDMUND BURKE BOATNER

See also INDIAN, AMERICAN (Indians of the Plains; illustration; Language); SIGNALING.

SIGNAL CORPS. See HOMING PIGEON (History); SIGNALING (Military Signaling).

SIGNAL HILL NATIONAL HISTORIC PARK. See CANADA (National Historic Parks).

SIGNALING is one way of passing information from one person or place to another. Signals are used when direct and unaided voice or direct written communication is impossible or undesirable.

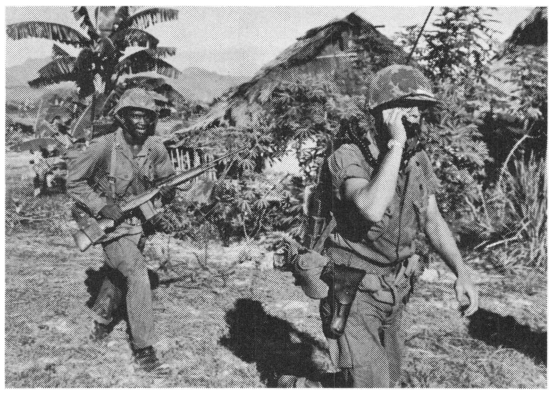
There are three main forms of signals: (1) electrical, (2) visual, and (3) sound. Various electrical, mechanical, and hand devices are used to transmit signals. International codes—such as the International Morse Code and the International Flag Code—have been developed for some kinds of signals. Such signals are the same throughout the world and can be understood anywhere. For more information on these, see FLAG (The International Flag Code); MORSE CODE.

Methods of Signaling

Visual and sound signals of one kind or another have been used since ancient times. Early methods included smoke signals, drum signals, and beacon fires. Electrical signals were first used in the early 1800's.

Visual and Sound Signals still have many uses today. Sound signals are made with such devices as bells, gongs, guns, horns, sirens, and whistles.

Visual signals are often made with flags. *Semaphore signaling* is done with two hand flags. The sender holds the flags in various positions to represent the letters of the alphabet and to give several other meanings. *Flaghoist signals* are made by hanging colored flags from crosspieces on the masts of ships. Both four-cornered flags and *pennants* (triangular flags) are used. Sailors often send messages with flaghoists by following the International Flag Code.



WORLD BOOK photo

Military Signaling. Soldiers often use radiotelephones to relay strategic information quickly from the battlefield.

Visual signaling can be done with lights. Light signals can be made with colored lights, with each light having a different meaning. Lights are often flashed or blinked according to some code. Signals may be passed by reflecting sunlight with mirrors. *Pyrotechnics* (fireworks) provide signals in which color is important. Pyrotechnic signals are made with various devices, including rockets, flares, smoke, and cartridges or shells fired from guns. Visual signals can also be made by hand and body movements, or by cloth *panels* (strips) laid flat on the ground or some other surface.

Electrical Signals can be transmitted in various ways. These include radio, radar, television, telephone, teletypewriter, and facsimile. Messages are often transmitted by a combination of these methods.

Objects can be found and accurately located by radar signals. A telegram or other message can be sent by teletypewriter. Computer information coded on magnetic tape or on punched cards or paper tape can be transmitted at high speeds by teletypewriters. Facsimile machines can transmit copies of maps, pictures, and printed materials. Communications satellites are used to carry electrical communication to any part of the world. Coaxial cables are also used to carry several types of electrical communication. Each of these means of electrical communication has a separate article in WORLD BOOK.

Important Uses of Signals

Throughout history, signals have been used in a wide range of activities. This article discusses only a few important uses. For information on other uses of signals, read the separate articles listed in the *Related Articles* at the end of this article.

Military Signaling. Armies use such modern electrical communications as radio, radar, telephone, teletypewriter, and television. Radio is used most often, but it is also the least secure means of communication. Radio can reveal the sender's position to the enemy. When secrecy is vital, radio messages are often sent in code.

The U.S. Army relies mainly on electrical communications. However, it also uses messengers and visual and sound signals. Visual signals include arm and hand signals, hand flags, panels, lights, and fireworks. Sound signals that are used include horns, gunshots, and whistles.

Aircraft Signaling. Radio signals are passed between ground stations and aircraft concerning take-off and landing instructions, the position of other planes, and weather information. In the Air Force, radio communication between pilots flying in the same group or formation is important. Some airplanes also have an *automatic direction finder*, or radio compass, and use omnidirectional radio range equipment. This equipment enables the pilot to locate his position at all times. Radar is used to guide aircraft to safe landings in any kind of weather, to help airplanes land on aircraft carriers, and to guide military aircraft to their targets. Visual signals that are used to aid pilots include beacons, running lights, wind socks, and approach light systems located at airports.

Marine Signaling. Various means of electrical communication are used by both commercial and naval vessels. Radio is used extensively in ship-to-ship communication, and for controlling naval aircraft. Radio and teletypewriter circuits connect ships at sea with stations ashore. Radar helps reveal the position of ships. Enemy submarines and explosive mines can also be detected by an echo-sounding device called *sonar*.

Lights, semaphore flags, and flaghoists are the most common means of visual signaling at sea. Sound signals include electrical sound-producing devices and such devices as bells, gongs, and whistles on *buoys* (floating markers) that are operated by the motion of the sea. Lights and fog signals on lighthouses, lightships, and buoys warn that ships are approaching land or dangerous hidden objects. Lights are also used as running lights on ships, and as signal searchlights. They are flashed or blinked to signal for help. Sailors use semaphore and flaghoists to relay information to nearby ships.

Distress Signals. A ship or aircraft in need of help can send several internationally agreed upon distress signals. Two of the best known are the radio signal *SOS* in code, which is used at sea, and the aircraft call of *Mayday* sent over voice radio. Other well-known distress signals include a gun fired at short intervals; a continuous sounding of fog signals; colored flares thrown from shells or rockets; the international flag signal *NC;* and flying the national flag upside down. These signals may be used either separately or in combination. Persons on land who are in urgent need of help sometimes make up signals or use variations of these standard signals.

PAUL J. SCHEIPS

Related Articles in WORLD BOOK include:

ILLUSTRATIONS OF SIGNALS

The following articles include illustrations of various methods of signaling:

Basketball	Communication	Football
Board of Trade	Deafness	Indian, American
Boating	Flag	Railroad

OTHER RELATED ARTICLES

Beacon	Morse Code	SOS
Codes and Ciphers	Radio (Uses)	Traffic
Fireworks	Semaphore	Weather
Heliograph	Sign Language	Whistle
Lighthouse	Siren	Wigwagging
Lightship		

SIGNATURE. See BOOKBINDING (Forming the Book).

SIGNATURE, LEGAL. A legal signature identifies a person and indicates his intention to stand by a signed document as written. It is usually his name, handwritten by himself or by another with his authority. If he is physically unable to write, his hand may be guided at his request. A person who has not learned to write may make an identifying mark, such as an X. In such cases, the conditions of signing must be described and witnessed according to law.

Courts have held that a signature written by any means is lawful. Properly witnessed wills have been held legal when the name of the person making the will appeared only in the phrase "I, John Doe, . . ." But some states require the signature at the end.

The first and last names make up a person's legal signature. Prefixes, titles, and middle names or initials are not legally necessary parts of a signature. But they may help to identify the individual. The United States government usually requests the middle name or initial for its records, because of the danger of confusing one person with others who have the same first and last names.

A married woman's given name followed by her husband's surname is her lawful signature even if she becomes a widow. But if she wishes to do so, she may sign with her husband's name preceded by "Mrs.," as "Mrs. John Doe." A divorced woman may also sign in these ways until the court permits her to take her maiden name again. A married woman may legally use her maiden name as her signature in connection with property which she owns independently of her husband.

Anyone can legally establish a new name and signature merely by using it all the time. State laws usually permit a person to have his name legally changed by a court if no fraud is intended. FRED E. INBAU

SIGNET RING. See SEAL (design).

SIGNORELLI, *seen yoh REL ee,* **LUCA DI EGIDIO DI VENTURA DE'** (1450?-1523), was one of the great Italian painters during the Renaissance. He is best known for his frescoes in the Cathedral of Orvieto. These wall paintings, *The Resurrection of the Dead* and *The Last Judgment,* show many powerful figures. He is admired for the clarity of his design. Signorelli was born in Cortona. WOLFGANG LOTZ

SIGNS OF THE ZODIAC. See ZODIAC.

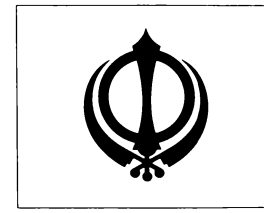
SIGURD, *SIHG urd,* is the Scandinavian name for the mythical German hero Siegfried. The stories about him probably originated in the A.D. 400's, and soon found their way to Scandinavia. They were given poetic treatment in the *Elder Edda,* a collection of poems composed in Iceland during the 1000's and 1100's. The prose *Saga of the Volsungs,* written in Iceland during the 1100's or 1200's, tells the stories about Sigurd more fully. KENNETH CHAPMAN

See also EDDA; FAFNIR; NIBELUNGENLIED; SIEGFRIED; VOLSUNGA SAGA.

SIHANOUK, NORODOM. See NORODOM SIHANOUK.

SIKHISM, *SEE kism,* is a religion of the Punjab region of northwestern India. A follower of Sikhism is called a *Sikh,* meaning a *disciple.* There are more than 8 million Sikhs, and almost all of them live in India. They are chiefly farmers and soldiers.

Sikhism was founded by Guru Nanak (1469-1538). He tried to unite the Moslems and all *castes* (classes) of Hindus into one brotherhood. He taught that there is one true, universal God. The central shrine of the Sikhs is in Amritsar. There, the *Granth* (holy book of the Sikhs) is read aloud every day.



The Symbol of Sikhism consists of two curved swords, a double-edged dagger, and a discus. The symbol stands for bravery and spiritual power.

The political state of the Sikhs was established by Govind Singh (1666-1708). He built up their military power, to protect them from the Moslems and other religious groups. But after Singh's death, the Sikhs were overcome by the Moslems. A few Sikhs escaped to the mountains. They returned a few years later and captured Lahore. The Sikh communities were united from 1799 to 1824 by Ranjit Singh, a skillful ruler who gave himself the title of *maharajah.* By 1824, Ranjit Singh's military talent brought most of India north of the Sutlej River under his control. After his death, the Sikhs fought the British in India. In the First Sikh War (1845-1846), they lost Lahore. In the Second Sikh War (1848), the British conquered them.

The Sikhs were afraid that Moslem power might be restored in India, and for this reason they backed the British during the Sepoy Rebellion in the late 1850's. The Sikhs supported Britain in World Wars I and II. In 1966, the Indian government, in response to Sikh demands, created Punjab, a separate Punjabi-speaking state in the Punjab region. GEORGE NOEL MAYHEW

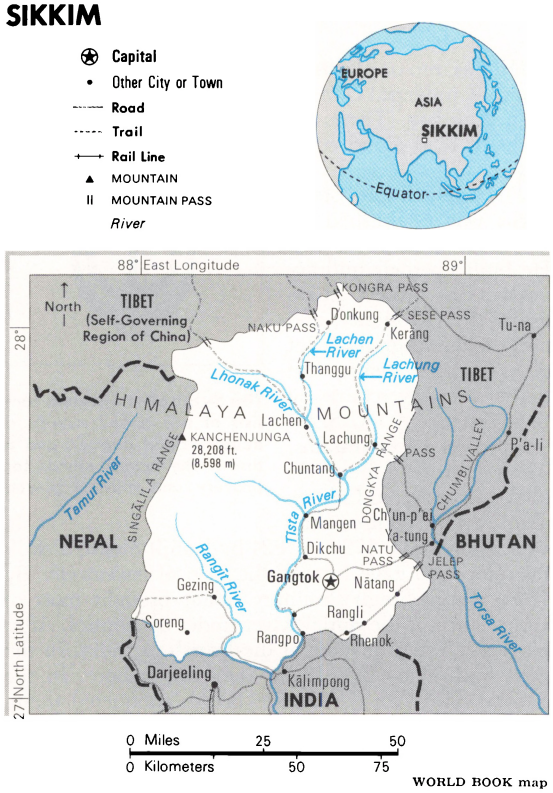
See also INDIA (Religion); PUNJAB; RANJIT SINGH; RELIGION (Life and Death).

SIKINNIS. See DANCING (Greek Dancing).

Pix

The Sikh Golden Temple stands in a pool of fresh water in Amritsar, the holy city of the Sikhs in India.

SIKKIM



WORLD BOOK map

SIKKIM, *SIH kim*, is an Indian state tucked away in the towering mountains of south-central Asia. It lies in northern India, in the heart of the high Himalaya. Mount Kanchenjunga, the third highest mountain in the world, lies on Sikkim's western border with Nepal. China lies to the north. An arc of great mountain peaks in the east separates Sikkim from China and Bhutan.

Sikkim is only about as big as the state of Delaware. Its geography ranges from snow-covered mountains more than 28,000 feet (8,530 meters) high to a thick, tropical rain forest that lies at sea level.

Sikkim was formerly a monarchy and a protectorate of India. It became an Indian state in 1975. Gangtok, a city of about 15,000 persons, is the state's capital and only city (see GANGTOK).

Government. Sikkim is one of the 22 states of India. As in other Indian states, a governor serves as head of Sikkim's government. The president of India appoints the governor. Sikkim also has a 32-member legislature elected by the people. The head of the majority party in the state legislature serves as the chief minister of Sikkim. See INDIA (Government).

People. Nepalese, Lepchas, and Bhutias make up most of Sikkim's population. Many Nepalese moved to Sikkim after 1890. Today, they make up about 70 per cent of the population. Most of them live on small farms in the middle altitudes in the southern part of the state. They work the fields with simple hand tools.

The Lepchas, first settlers in Sikkim, were pushed aside by later settlers. Today, they live in distant valleys. Many hunt and fish for food, and others farm or raise livestock. In some areas, Nepalese farmers have cleared many forests to plant crops. This has destroyed the hunting grounds of the Lepchas and has caused trouble between the two groups.

The Bhutias came to Sikkim from Bhutan and Tibet in the 1600's. Today, they herd cattle and *yaks* (Asian oxen). In the summer, they live in tents and graze their herds in high mountain meadows. In the winter, they live in wooden houses in the highlands.

Lepchas and Bhutias practice Tibetan Buddhism. Over half of the people, including most Nepalese, are Hindus. But their Hinduism has been influenced by Buddhism.

Most of the Nepalese in Sikkim speak Gurkhali. Most of the Lepchas and Bhutias speak Sikkimese. English is also used. About 2 out of 10 persons in Sikkim can read and write.

Land. People cannot live in many parts of Sikkim, because the mountain land is too rocky and barren. Over thousands of years, the streams flowing down the mountains into the Tīsta River have cut into the mountainsides, and formed a basin in south-central Sikkim. This basin is 40 miles (64 kilometers) wide.

The highest mountain peaks are covered with snow all year. The lower slopes have cool, grassy meadows. Still farther down are warm forests and hot, rainy areas. Tropical rain forests grow in the southern river valley bottoms, where heavy rains fall. Rainfall in Sikkim varies from 200 inches (500 centimeters) to less than 40 inches (100 centimeters) a year.

Economy. Sikkim's economy is based on agriculture, and most of the people are farmers. Some farmers raise rice, corn, and other cereal crops to feed the people. Others raise apples, *cardamom* (a spice), citrus fruits, pineapples, and potatoes.

Handicrafts provide the chief industry. Craftsmen weave cloth, blankets, and rugs, and make copperware and woodcarvings. Sikkim's first hydroelectric power project was finished in 1961, and others are being built. Poor roads often hamper transportation in Sikkim. About 300 miles (480 kilometers) of roads link Sikkim with other parts of India. Sikkim has no railroads or airports.

Forests cover almost a third of Sikkim. The state has some copper, lead, and zinc deposits.

History. Sikkim became an independent monarchy about 1640, when Penchu Namgyal was crowned *chogyal* (king). Sikkim then controlled lands that are now part of Bhutan, China, India, and Nepal. In 1780, warriors from Nepal and Bhutan invaded Sikkim and seized much of the land. Britain defeated the Nepalese in 1814 and restored some land to Sikkim.

FACTS IN BRIEF

Capital: Gangtok.

Form of Government: State of India.

Area: 2,744 sq. mi. (7,107 km²). *Greatest Distances*—north-south, about 70 mi. (110 km); east-west, about 55 mi. (89 km).

Population: *Estimated 1976 Population*—219,000; distribution, 92 per cent rural, 8 per cent urban; density, 80 persons per sq. mi. (31 persons per km²). *1971 Census*—204,760. *Estimated 1981 Population*—241,000.

Chief Products: *Agriculture*—rice, corn, cardamom. *Mining*—copper, lead, zinc.

Money: *Basic Unit*—Indian rupee.

In 1861, Britain made Sikkim a protectorate, and a British official later took over much of the chogyal's power. By 1918, the chogyal had regained control of internal matters. Britain gave India control over Sikkim in 1947. In 1950, Sikkim agreed to Indian control of its defense, foreign relations, and vital communications. In 1963, Chogyal Palden Thondup Namgyal married Hope Cooke, an American. She left Sikkim in 1973 and went to New York to live. That year, anti-government demonstrations led the chogyal to accept some political reforms that reduced his power.

India gradually gained more and more control over Sikkim's affairs. In April, 1975, Sikkim's legislature voted to become a state of India, in spite of opposition from the chogyal. A special referendum was then held, and Sikkimese voters approved the proposed statehood by a large margin. Sikkim ended more than 300 years as a monarchy in May, 1975, when it officially became a state of India. ROBERT I. CRANE

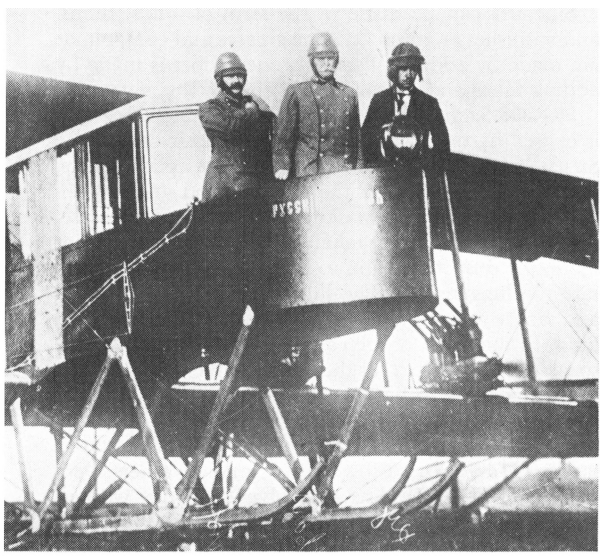
SIKORSKY, *sih KAWR skih,* **IGOR IVANOVICH** (1889-1972), an aircraft designer and manufacturer, pioneered in multiengine airplanes, helicopters, and transoceanic flying boats. He designed the world's first four-engine aircraft in 1913. He produced a successful single-rotor helicopter in 1939 (see HELICOPTER).

Sikorsky was born in Kiev, Russia. He was educated at the Petrograd Naval College and at engineering schools in Paris and Kiev. He first attempted to build helicopters, but failed because he lacked suitable engines. He then concentrated on fixed-wing aircraft and rose to a prominent position in Russian aviation, designing one of the most successful bombers of World War I (1914-1918). Sikorsky came to the United States in 1919. He founded a company in 1923 which produced flying boats. It became part of the United Aircraft Corporation (now United Technologies Corporation) in 1934. Sikorsky then worked on designing and building helicopters. ROBERT B. HOTZ

See also AIRPLANE (Other Pioneer Planes [picture]).

Igor Sikorsky, *right,* **built and piloted the first successful four-engine airplane in 1913.**

Brown Bros.



SILAGE. See SILO.

SILAS MARNER. See ELIOT, GEORGE.

SILENCE, TOWER OF. See TOWER OF SILENCE.

SILENUS. See MIDAS.

SILESIA is a region in southwestern Poland and north-central Czechoslovakia. It includes the upper Oder River Valley and the Sudetes Mountains. Silesia covers 19,029 square miles (49,286 square kilometers) and has a population of more than 9 million. Katowice and Wrocław, Poland, are the principal cities.

Silesia manufactures machinery, metals, and other products. Its minerals include coal and iron. Farmers in Silesia raise grains, potatoes, and sugar beets.

The region became part of Poland in the 900's. Austria took over Silesia in 1526 and Prussia seized northern Silesia from Austria in 1742. In 1919, after World War I, Germany and Poland divided northern Silesia and southern Silesia became part of Czechoslovakia. Poland gained control of the entire northern part in 1945, after World War II. ADAM BROMKE

SILHOUETTE, *sil oo ET,* is an outline drawing filled in with solid color to resemble a shadow. The term usually refers to a profile, or side view, of the head. This kind of portrait was named for Étienne de Silhouette (1709-1767), a French minister of finance.

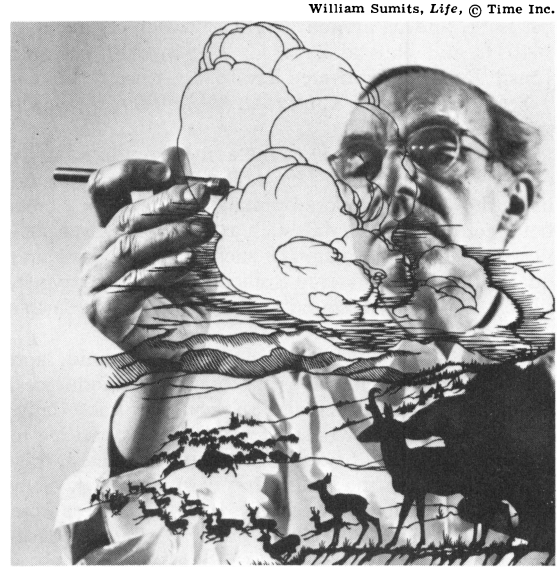
The easiest way to make a silhouette is to place a small object, such as a leaf, a shell, or a key, on a piece of paper. Draw a line around the edge of the object with a pencil, and fill in the outline with a dark color.

A silhouette portrait may be made by drawing an outline around a person's shadow. The person should sit between a lighted candle and a piece of paper on the wall. Another method is to photograph a person against the light of a window. HARRY MUIR KURTZWORTH

SILICA, *SIL ih kuh,* is the name for silicon dioxide. It is the most abundant and widely distributed substance in the earth's crust. About 60 per cent of the

Animal Silhouettes and a detailed background can be cut out of a black sheet of paper by using a special knife.

William Sumits, *Life,* © Time Inc.



earth's crust is silica. It is a material in the formation of most common and crystalline rocks. Crystalline silica forms the minerals coesite, cristobalite, quartz, stishovite, tridymite, and others.

As quartz, silica makes up the largest part of sand. Pure quartz sand is used in making glass and firebrick. Crystals of quartz, both natural and artificial, are used to keep radio transmitters and receivers tuned. Silica combines with other substances to form minerals called *silicates*. It gives strength to some plant stalks, the quills of feathers, and some living sponges. It also makes up the shells of some microscopic forms of life.

Silica has the chemical formula SiO_2. It occurs in both crystalline and *amorphous* (without definite structure) forms. Silica dissolves only slightly in water or in any mineral acid except hydrofluoric acid. CECIL J. SCHNEER

Related Articles in WORLD BOOK include:

Glass	Opal	Sand	Silicosis
Hornblende	Quartz	Silica Gel	

SILICA GEL is a colloidal form of silica that has a powerful affinity for water. This material, when dried, removes water vapor and other gases from air. Silica does not react with many materials and therefore it is a safe substance to insert into a pipe as a filter. When the filter is saturated, it can be cleaned merely by heating the silica. When water is removed from silicic acid, a gel of silicon dioxide, or *silica gel*, is precipitated. The silica in this gel is porous. Silica gel is therefore valuable as a gas filter. GEORGE L. BUSH

SILICATE. See CERAMICS; SILICA.

SILICON is a hard, dark gray chemical element. Except for oxygen, it is the most common element in the earth's crust. It makes up the major portion of clay, granite, quartz, and sand. Silicon compounds have many uses. *Silica* (silicon dioxide) is a principal ingredient in glass. Silicon carbide (SiC), one of the hardest substances known, is used to grind and polish other materials. Silicon is used in the manufacture of transistors because, among other reasons, it withstands heat well and is relatively inexpensive.

Silicon has the chemical symbol *Si*. Its atomic number is 14, and its atomic weight is 28.086. It melts at 1410° C and boils at 2355° C. The Swedish scientist Jöns J. Berzelius discovered it in 1823. FRANK C. ANDREWS

See also ELEMENT, CHEMICAL (tables); SILICA; TRANSISTOR.

SILICONE, *SIL ih kohn,* is the name given to a family of man-made materials. They are unlike anything found in nature or made before by man. Silicones are a cross between organic materials such as oil, rubber, and plastics, and inorganic materials such as sand, glass, and quartz. Their key material is silicon. Except for oxygen, silicon is the most abundant material in the earth's crust (see SILICON).

Uses. Silicones, which come in solid, liquid, and gaseous forms, are now in use in thousands of industries. Scientists are discovering new applications almost daily. As release agents, silicones keep bread from sticking to pans in commercial bakeries. Clean and smokeless, they work better than the grease that was once used. They also keep tires and other rubber and plastic parts from sticking in the molds. Silicone fluids are used as polishing agents for automobiles, furniture, and eyeglasses. They keep instrument pointers on automobile dashboards from wobbling. Fabric and leather treated with silicone will not absorb water or water-based products such as ink and tomato juice. Repeated washing or dry cleaning will not remove the effect of the silicone. Yet silicone will not stiffen the fabric.

Silicone oils and greases serve as permanent lubricants for clocks and ball bearings. Silicone water repellents keep brick and concrete walls dry in the rain. Some hand lotions contain silicone. Paints made with silicone resins do not blister and peel off at temperatures of 500° to 1000° F. (260° to 540° C). Outdoor weathering does not make them lose their gloss and color. Silicone paints are often used on ships.

As electrical insulating materials, silicones make hard-working motors, generators, and transformers last 10 to 100 times as long as they ever did before. They make it possible for a 10-horsepower (7.5-kilowatt) motor to do as much work as a 15-horsepower (11-kilowatt) motor.

Silicone rubber does not melt at oven temperatures or become hard and brittle at temperatures from −70° to −110° F. (−57° to −79° C). It is used to seal oven doors and rocker boxes on aircraft and tank engines. It stays flexible enough to seal bomb-bay doors when they open and close on high altitude bombers. Silicone rubber insulates communications cables on naval vessels and motor coils in diesel-electric locomotive motors.

Composition. The amount of heat, weathering, and aging a material can stand is determined by the strength of the bond that holds the atoms together. Silicones are several times as heat-stable and weather-resistant as organic materials. Like sand, glass, and quartz, silicones have a molecular skeleton of alternate silicon and oxygen atoms. And the links in this chain are strong. The linkage, or bond strength, between silicon and oxygen is about one and a half times as great as the carbon-to-carbon bond that holds organic molecules together.

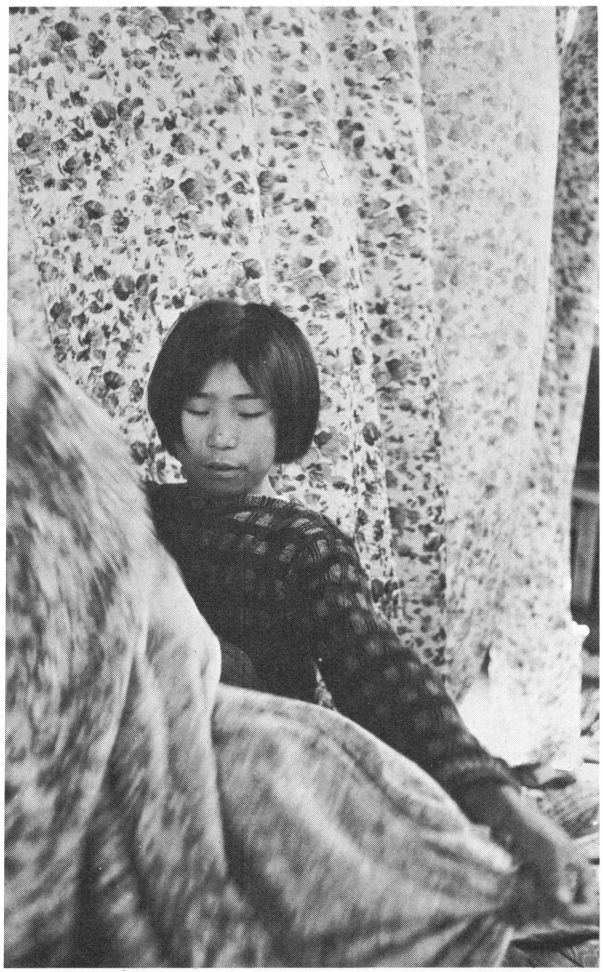
In making silicone products, "flesh" is put on the silicon-oxygen skeleton with certain organic groups. These organic groups give the silicones such useful properties as water repellency, lubricating properties, flexibility, and ease of handling.

Silicones can be made in the form of fluids, resins, and varnishes or gums. Silicone greases and compounds are made by adding fillers. Silicone rubber is made by adding fillers and vulcanizing agents. W. R. COLLINGS

SILICOSIS, *SIL ih KO sis*, is a disease of the lungs that is caused by breathing in dust that contains silica (see SILICA). Granite cutters, roadbuilders, glassmakers, blasters, and workers in the abrasive and grinding industries are especially in danger of getting this disease.

If a person regularly inhales silica dust for a year or more, the dust may begin to lodge in the lung and irritate the lung tissues. The lung may become inflamed and tiny swellings may begin to develop all over the lung. In the midst of each swelling, or *nodule*, there is a speck of silica dust. This dust has a bad chemical effect upon the body. Silicosis usually causes short breath, coughing, and chest pains. As time goes on, the body becomes weaker and the person may get tuberculosis.

Silicosis has caused the death of many workers every year. Preventing the disease involves supplying workers with masks, respirators, or nose filters. Ventilating systems help prevent the disease. M. D. ALTSCHULE



René Burri, Magnum

Silk, the *Queen of Fibers,* has a radiance and beauty that few other fibers can equal. The silk worker, above, is folding silk cloth that will be made into dresses. Women wear silk dresses for both daytime and evening wear. Much silk is also used in curtains, upholstery materials, and neckties.

SILK is a strong, shiny *fiber* (threadlike substance) that is used to make cloth. Silk has a natural beauty that few other fibers can equal. Because of its beauty, silk is often called the *Queen of Fibers*. Silk fiber is made from the cocoons of caterpillars called *silkworms*. Many other animals, including spiders and lacewings, spin silk threads. But their silk cannot economically be made into cloth.

Silk is the strongest of all natural fibers. A thread of silk is stronger than the same size thread of some kinds of steel. Silk is highly elastic. It can be stretched and will still return to its original shape. Silk garments are extremely light in weight, and are warmer than cotton, linen, or rayon clothing. Dyed silk cloth has a deeper, richer appearance than most other dyed fabrics. Silk can be ironed easily, and it resists wrinkling.

Silk is used widely in making women's fashionable clothing and men's high quality neckties. It is also used in upholstery and curtain materials, especially in mixed fabrics.

Japan produces more raw silk than any other country. Mainland China ranks second. Other leading silk producers include Russia, India, Italy, and South Korea. The United States is the world's leading manufacturer of silk products.

Sources of Silk

Cultivated Silk is spun by silkworms that are raised on silk farms. Almost all commercial silk is cultivated. Most high quality cultivated silk is produced by the caterpillars, or larvae, of a moth called *Bombyx mori*. The first part of its name comes from *Bombycidae*, the family of moths to which it belongs. The last part comes from *Morus multicaulis*, the scientific name of the mulberry tree, on which it feeds.

The *Bombyx mori* is a rather large white moth, with black-lined wings. From wing tip to wing tip, the moth measures a little more than 2 inches (5 centimeters). Its body is short and thick, and its legs are stout.

Wild Silk, called *tussah*, comes from silkworms that feed chiefly on oak leaves. These worms grow wild, mainly in China and India. Tussah is difficult to bleach because its natural color is tan or brown. It is less shiny than cultivated silk. Tussah is used as a filling in fabrics and is often blended with other fibers.

Raising Silkworms

The raising of silkworms requires a great deal of care and patience. Silk farmers treat the *Bombyx mori* as carefully as they would a newborn baby. They raise it under carefully controlled temperatures. They protect it from mosquitoes, flies, and other insects.

Production of Silkworms. In early summer, a female *Bombyx mori* lays from 300 to 500 eggs. It deposits them on special strips of paper provided by the silk farmer. The moth dies soon after it lays its eggs. The eggs undergo many tests to make sure they contain perfect, disease-free worms. Then they are put in cold storage. Early the next spring, the silk farmer puts the eggs in an incubator. An *incubator* is a device for keeping the eggs at a suitable temperature for hatching. About 20 days later, the eggs hatch into tiny silkworms.

Development of Silkworms. The young silkworms are put on trays that are kept spotlessly clean to prevent disease. At first, the silkworms have enormous appetites. They eat almost continually, both night and day. The silk farmer supplies them with fresh mulberry leaves every two or three hours. During this time, the worms grow to about 70 times their original size and shed their skins four times. After four to five weeks, the silkworm is about 3 inches (8 centimeters) long and nearly 1 inch (2.5 centimeters) thick. Its body has 12 sections and three pairs of legs.

Spinning the Cocoon. When fully grown, the silkworm stops eating and is ready to spin its *cocoon* (outer wrapping). The worm creeps into a tiny wooden compartment containing twigs or stems of straw that the

Hans Vaterlaus, the contributor of this article, is former Executive Vice-President of the International Silk Association (U.S.A.), Inc.

farmer has prepared. The worm spins a net or web to hold itself to a twig or stem. It then forms a cocoon, which is the silk. To do this, it swings its head from side to side in a series of figure-eight movements. Two glands near the silkworm's lower jaw give off a fluid that hardens into fine silk threads as it hits the air. At the same time, it gives off a gum called *sericin*. The sericin cements the two threads of silk together.

The silkworm spins the silk around and around its body. It does not stop until all the fluid has been used. Finally, after about three days of spinning, the cocoon is completed. The worm then changes into a *pupa*, the third stage of its life cycle. If permitted to live, the pupa becomes a moth in about three weeks. This would complete the life cycle, or *metamorphosis*, of the *Bombyx mori*—egg, silkworm (caterpillar), pupa, and moth (see METAMORPHOSIS).

When a pupa changes into a moth, it bursts the cocoon and breaks the one long silk thread into many short ones. For this reason, silk farmers allow only a small percentage of pupas to develop into moths. These moths are kept to lay the next batch of eggs. To save the silk, the other insects are killed before they break their covering. Silk farmers usually kill the insects by placing the cocoons in a hot oven.

Processing Silk

Reeling. After the pupa has been killed, silk workers are ready to *reel* (unwind) the long delicate threads of the cocoon. This is done in a reeling factory called a *filature*.

The cocoons are soaked in basins of hot water to dissolve the gummy sericin that holds the threads together. Threads from several cocoons are unwound at the same time, because a single *filament* (slender thread) is far too fine to be reeled separately. As the cocoons bob about in the basin, their filaments are drawn together and pulled by pulleys through a tiny porcelain *guide*. The guide is much like the eye of a needle.

The melted sericin glues several silk filaments into a single thread, which is wound onto a reel. Later, the silk is removed from the reel and twisted into *skeins* (small coiled bundles). Fifteen double skeins or 30 small skeins are bound into a larger bundle called a *book*. A bale of raw silk ready to be shipped to a mill for weaving contains about 30 books and weighs about 135 pounds (61 kilograms).

Throwing. The raw silk is now much stronger than it was when it left the cocoon. But it is still not strong enough to be woven into anything except the sheerest material. It is strengthened by a series of processes called *throwing*. The term comes from the Anglo-Saxon word *thraw* (twist). Throwing is increasing the twist or adding strands and twisting them together.

The number of threads thrown together depends on the fabric to be woven. Most raw silk used to make the *woof* (crosswise threads) is thrown with a certain twist. But much silk used for the *warp* (lengthwise threads) is reeled in heavier sizes, and need not be thrown.

Boiling Off and Weighting. When the silk comes from the throwing machines, there is still too much sericin on it. Workmen boil the silk in a solution of hot soap to remove the sericin. This process is called *boiling off*. The removal of the sericin uncovers the natural

Eastfoto

Thousands of Cocoons are piled high on the floor of a silk factory. Workers use machines to unwind the long, delicate threads from the cocoons. The threads of several cocoons are drawn together to form a strand strong enough for commercial use.

Eastfoto

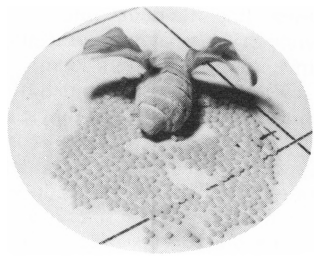
Laboratory Workers Examine Silkworms under a microscope to see if they are healthy. The industry produces top quality silk by permitting only healthy worms to live and spin cocoons.

THE SILK CYCLE

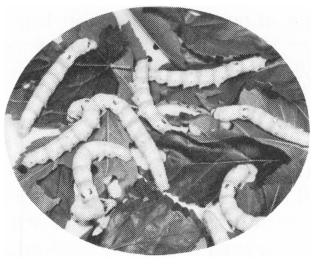
The making of a fine silk garment completes a long process that includes the life cycle of the silkworm. During this process, the silkworm's delicate cocoon is made into silk thread, which is woven into beautiful silk fabric.

Japan Silk Association; Japan National Tourist Organization

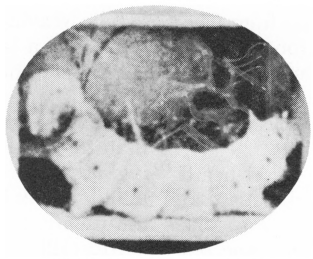
1. Moth coming out of cocoon



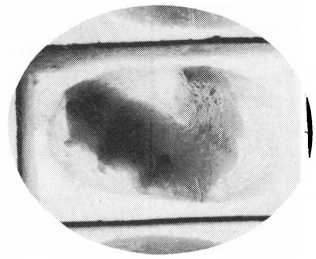
2. Moth laying eggs



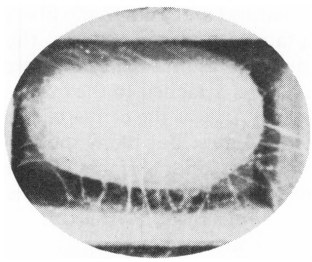
3. Feeding young silkworms



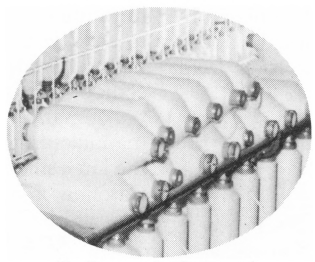
4. Full-grown silkworm



5. Silkworm making cocoon



6. Completed silk cocoon



7. Cones of silk thread

8. Finished silk garments

beauty of the silk. Boiled-off silk is usually milky white. The sericin can be removed either before or after weaving, depending on the type of fabric. Boiling off causes the silk to lose about 25 per cent of its weight. Before World War II, silk fabrics were often *weighted* (loaded) with mineral salts to make up for this loss in weight. But heavily weighted silk cracks and tears much more easily than *pure-dye* silk. In 1938, the U.S. Federal Trade Commission established strict trade-practice rules for the silk industry. Today, U.S. manufacturers do not weight silk. Most European silk fabrics are still weighted. But the amount of weighting must be stated on a label attached to the garment.

Dyeing. Brilliant dyes may be applied to silk yarn before it is woven. This type of dyeing is called *skein dyeing*. Some silk fabrics are dyed after they are woven. This process is called *piece dyeing*.

Weaving. Silk yarns are woven on looms much like those used for cotton and wool. Automatic power looms have replaced hand-weaving methods in almost all countries. Many silk fabrics, including damasks and heavy evening wear fabrics, are woven on Jacquard looms. Beautiful designs or patterns can be woven on these looms. See JACQUARD.

Douppioni are uneven, double silk threads. They come from two silkworms that have nested together and spun one cocoon around the two of them. In processing, the double threads are not separated. Fabrics woven from douppioni thread have a knotted or twisted appearance. Douppioni are used for the filling in shantungs and other rough weaves (see SHANTUNG).

Spun Silk. Not all silk can be reeled and thrown for weaving. When a moth bursts its cocoon, it breaks the one long filament into several short ones. These pierced cocoons and the beginnings and ends of reeled-off cocoons are silk *wastes*. These fibers are spun into silk yarn. Spun silk is used for the filling in some silk, woolen, and cotton fabrics.

History

Discovery of Silk. No one knows for sure when silk was discovered. According to a Chinese legend, it was discovered about 2700 B.C. in the garden of Emperor Huang-Ti. The emperor ordered his wife, Si-Ling-Shi, to find out what was damaging his mulberry trees.

Si-Ling-Shi found white worms eating the mulberry leaves and spinning shiny cocoons. She accidentally dropped a cocoon into hot water. As she played with the cocoon in the water, a delicate, cobwebby tangle separated itself from the cocoon. Si-Ling-Shi drew it out and found that one slender thread was unwinding itself from the cocoon. She had discovered silk.

Si-Ling-Shi persuaded her husband to give her a grove of mulberry trees, where she could grow thousands of worms that spun such beautiful cocoons. It is said that Si-Ling-Shi invented the silk reel, which joined

these fine filaments into a thread thick and strong enough for weaving. Some stories also credit her with inventing the first silk loom.

No one knows how much, if any, of this story is true. But historians do know that silk was first used in China. The Chinese guarded the secret of the silkworm. Disgrace and death faced the traitor who disclosed the origin of silk to the outside world. Only the Chinese knew how to make silk for about 3,000 years.

Silk Making Spreads. China carried on a profitable silk trade with Western nations in the days of the Han Dynasty (founded in 202 B.C.). Traders from ancient Persia (now Iran) bought richly colored silks from Chinese merchants. Camel caravans blazed routes across Asia, transporting silk from China to Damascus, the market place at which East and West met. From Damascus, silk was taken to the Roman Empire, where there were riches to exchange for it.

As early as the 300's B.C., the Western world heard rumors of the strange worm that spun silk threads. But no one in the West saw the worm until about A.D. 550. At that time, Persia controlled all silk that came out of China. Persians sold it at fabulously high prices.

The Roman, or Byzantine, emperor Justinian objected to paying high prices to the Persians. In about 550, he tried unsuccessfully to find a trade route from Constantinople (now Istanbul) to China that would bypass Persia. He later sent two monks to China as spies. Risking death, they smuggled out silkworm eggs and mulberry seeds in hollow bamboo canes. This adventure ended the Chinese and Persian silk monopolies.

New York Public Library

Ancient Silk Farming. Japanese women of long ago sliced mulberry leaves and fed them to hungry silkworms.

During the next few hundred years, various peoples learned how to raise silkworms and take silk from the cocoons. The Moslems brought silkworms to Spain and Sicily in the 800's and 900's. By the 1200's, Italy had become the silk center of the West. Silk weaving began in France in the late 1400's. The French soon rivaled the Italians as silk manufacturers.

Silk weaving became an important industry in England after a large number of skilled Flemish weavers entered the country in 1585. The first silk factory in the United States was built in Mansfield, Conn., in 1810.

Silk Making Today. Before World War II, the hosiery industry was the biggest user of raw silk. Now most stockings are made of nylon. At one time, there was also a demand for silk lingerie and ribbons. Now these products are usually made of synthetic fibers. See SYNTHETICS.

Most silk produced today is used in making clothing, neckwear, curtains, and upholstery. Silk is being used in combination with other natural and man-made fibers to achieve new effects in fabrics. For such fabrics, the Federal Trade Commission requires that the exact fiber composition be stated on a label attached to the fabric.

For many years, Paterson, N.J., was the center of silk manufacturing in the United States. But today most of the large silk mills are in Pennsylvania, Virginia, South Carolina, and North Carolina. HANS VATERLAUS

See also COCOON; MOTH; MULBERRY; PATERSON.

SILK ROAD. See KUSHAN EMPIRE.

SILK-SCREEN PRINTING is a means of printing with stencils. The process is used in making fine art pictures and in commercial printing. Silk-screen printing may be used to print on almost any surface. It is unique because any kind of ink or paint may be used. Silk-screen printing has many uses. Labels on bottles; prints on textiles; and decorations on toys, glass, china, earthenware, and furniture are printed in this way.

The equipment for silk-screen printing consists of a piece of stencil silk, called *bolting cloth*, stretched across a wooden frame. The stencil pattern can be applied to the silk in many ways. Some patterns are painted directly on the silk with glue or shellac. More complicated stencils may be cut from special stencil sheets called *pro-film*. Most frequently, photographic stencils, much like the negative film in cameras, are used.

The stencil is placed on the silk screen, which acts as its support. A *squeegee*, similar in principle to the kind used for cleaning windows, is used to force the ink or paint through the stencil and the screen onto the surface to be printed.

One or more colors may be used in silk-screen printing, as in other types of printing. There is a new stencil pattern for each color, and each new color is applied only after the preceding color has dried. As a result, a four-color print may take several days to complete.

In fine art printing, silk-screen printing is called *serigraphy*, from the Latin *seri*, meaning *silk*, and the Greek *graphein*, meaning *to draw*. Stencil printing is one of man's oldest arts. It developed into a fine art in the

Orient, and gradually spread to Europe. In 1907, Samuel Simon in England received the first patent granted for silk-screen stencil printing. HARRY STERNBERG

SILKWORM. See SILK.

SILKY TERRIER is a toy dog developed about 1900 in Sydney, Australia. It is descended from a cross between the Australian and Yorkshire terrier. Australians keep the dogs as pets and once used them on farms to kill rats and snakes. Silky terriers have erect ears; *docked*, or cut off, tails; and long silky hair with tan markings. The dogs weigh about 8 to 10 pounds (3.6 to 4.5 kilograms). JOSEPHINE Z. RINE

WORLD BOOK photo by E. F. Hoppe

The Silky Terrier

SILL. See HOUSE (The Frame).

SILLIMANITE, *SILL ih mun ite* (chemical formula, Al_2SiO_5), is an uncommon substance that belongs to the large class of minerals known as silicates (see SILICA). It is sometimes called *fibrolite*. It may be brown, pale green, or white, and it has a glassy luster. It occurs in central Europe, Brazil, and the United States.

SILLS, BEVERLY (1929-), an American singer, became one of the great operatic sopranos of the mid-1900's. She won fame for her extraordinarily flexible voice and rich, warm tones.

Miss Sills's musicianship and ability to perform in a variety of operatic styles made her popular with both audiences and musicians. She became noted for her performances of works by such diverse composers as Gaetano Donizetti, George Frideric Handel, and Giuseppe Verdi. Miss Sills also earned recognition as a fine actress in such roles as Cleopatra in Handel's *Julius Caesar* and as Violetta in Verdi's *La Traviata*.

Chicago Daily News

Beverly Sills

Beverly Sills's real name is Belle Silverman. She was born in New York City and received her training there. Miss Sills made her operatic debut in 1946 and joined the New York City Opera in 1955. She sang with leading European opera companies. She made her Metropolitan Opera debut in 1975 in Rossini's *The Siege of Corinth.* KEITH POLK

SILO, *SY loh*, is a storage bin for chopped green plants used as livestock feed. Silos make it possible for farmers to supply livestock with juicy, tasty feed all year. Before silos were invented, cows gave less milk during winter because they had no green grass to eat.

Farmers use machines to chop up the plants. The chopped material is called *silage*. Machines blow the silage in at the top of the silo. It is removed from the bottom. Most American farmers use corn and juicy grasses called *sorghums* for silage.

If silage is packed properly, all air is forced out. Feed does not spoil in a silo, because molds that cause feed to spoil cannot survive without air. Chemical changes that occur in the silage called *fermentation* also help prevent rotting. Acids produced by fermentation help to prevent the growth of molds. If a feed does not have enough starch or sugar for fermentation, farmers may add hydrochloric acid, sulfur dioxide, sodium metabisulfite, or other acids to the feed to keep it from spoiling. Molasses or ground grains may be used to make *legumes* (pea plants) into silage. They contain starches and sugars that help to start fermentation.

Americans learned how to make silos from Europeans in the 1870's. The first silos were pits covered with boards. Then Fred L. Hatch, an Illinois farmer, built a square, wooden silo above ground in 1873. But its square corners made it impossible to pack the feed tightly. Air got in, and much of the feed spoiled. In 1882, Franklin H. King, an agricultural scientist in Wisconsin, built a round silo. Round silos resist the pressure of tightly packed feed best. Today, tall round silos are built throughout the world. They are made of stone, brick, clay tile, sheet metal, concrete, or wood blocks. Airtight, glass-lined steel silos are widely used in areas where farmers use silage all year.

Other types of silos include *trench*, *bunker*, and *box* silos. The trench silo is made by digging a shallow, narrow ditch in the ground, filling it with silage, and then covering it with a sheet of heavy plastic. The bunker silo is built above ground, and usually has wood or concrete sides. One or both ends may be left open. The box silo also is built above ground with poles and wood siding. Livestock can take feed from these types themselves. Temporary *plastic silos* can be made by piling silage on a sheet of plastic placed on the ground, then covering the pile with a second sheet of plastic. After a vacuum pump removes all the air, the two sheets of plastic are sealed. ALLEN D. TILLMAN

SILONE, IGNAZIO. See ITALIAN LITERATURE (The 1900's).

SILT is a fine-grained or muddy material made up of tiny particles of rock that settle at the bottom of rivers and other bodies of water. A material which sinks in water or air is known as *sediment*. Common examples of sediment are silt, sand, gravel, mud, and dust, or soil. Silt is made up of particles ranging from .01 to .1 mm (.0004 to .004 inches) in diameter. Most lands with silt deposits are fertile. ELDRED D. WILSON

SILURIAN PERIOD. See EARTH (table).

SILVER (chemical symbol, Ag). Some of the most useful and beautiful objects of the world are made from this lustrous, moonbeam-colored metallic element. Silver was known and used by primitive men. The ancient Hebrews knew it by a name meaning *pale*. The Greeks called it a name meaning *shining*. The chemical symbol for silver, Ag, comes from its Latin name, *argent*.

The sterling tableware treasured in many homes is made from silver. Valuable ornaments and jewel settings also are made from the metal. Silver is used in surgery and dentistry. The photographic industry, the world's largest silver consumer, uses it for purposes ranging from coating the film to developing it.

Properties of Silver. Silver is harder than gold, but softer than copper. It can be hammered out into sheets so thin that it would take 100,000 of them to make a stack 1 inch (2.5 centimeters) high. These sheets are so thin that light shines through them. Silver also may be drawn out into wires finer than human hair. It is the best conductor of heat and electricity among the metals. But its high cost usually prohibits its use in electrical conductors.

The atomic weight of silver is 107.870 and its atomic number is 47. Silver melts at a temperature of about 1761° F., or 960° C. When melted, silver can absorb as much as 20 times its own volume of oxygen.

One of the most interesting experiments of the chemical laboratory is to expose molten silver to the air. As the silver absorbs oxygen, it swells larger and larger. Then, when the metal cools and becomes solid again, it gives up the oxygen and slowly shrinks back to its original size. If the silver cools too fast, a crust forms on top of the mass before all the oxygen gets out, and bubbles of oxygen form in the metal. The bubbles grow larger and finally explode through the crust, driving out balls of silver with soft, swooshing noises. This action is known as *spitting*. It takes place only in pure silver. In working silver for commercial purposes, spitting is prevented by adding a small amount of some other metal to molten silver. Silver is not changed by moisture, dryness, alkalis, or vegetable acids. But sulfur, or air that contains sulfur, will cause silver to turn black. For this reason silver tarnishes very quickly in places where coal gas, which contains sulfur, is likely to creep in.

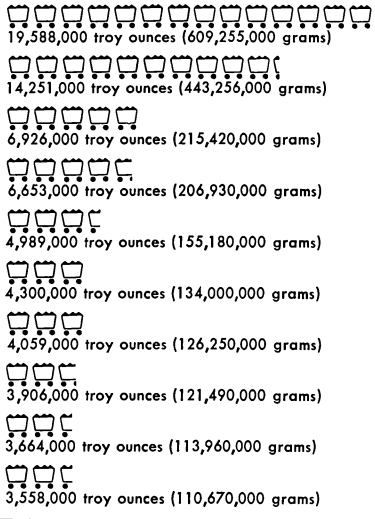
Sources of Silver. Pure silver is mined chiefly in Mexico and Peru; the provinces of British Columbia and Ontario in Canada; the state of New South Wales in Australia; and Arizona, Idaho, and Montana in the United States. The most important silver ores are *sulfides*, or ores containing sulfur. The richest ore mineral of silver is called *argentite*. It is classified as a simple sulfide because it contains pure silver and sulfur. Argentite is made up of two parts silver to one part sulfur.

The other sulfides are more complex and are found chiefly in Mexico, Peru, Bolivia, Chile, and Idaho. *Light ruby silver* contains arsenic, sulfur, and silver. *Dark ruby silver* contains antimony, sulfur, and silver. *Brittle silver* is made up of the same combining elements as dark ruby silver. Other important silver ores include *horn silver*, which contains chlorine and silver, and *hessite*, a compound of silver and tellurium. Galena, the chief ore of lead, often carries silver. In most of the silver-producing countries of Europe, silver is found in lead ores. There is a valuable lead mine in the Coeur d'Alene district of Idaho, where silver is mined in large quantities. Silver occurs with copper in the Butte (Mont.) district. A famous silver-copper mine is in Mansfeld, East Germany (near Halle). Sometimes silver is found alloyed with other metals, such as gold, mercury, and copper.

Silver Production. The world's richest silver mines are in North America. Canada, Mexico, Peru, and Russia produce over half the world's supply of silver. Canada, Peru, and Russia compete for first place among the silver-producing countries of the world.

LEADING SILVER-MINING STATES, PROVINCES, AND TERRITORIES

Silver mined in 1972



Sources: U.S. Bureau of Mines; Statistics Canada.

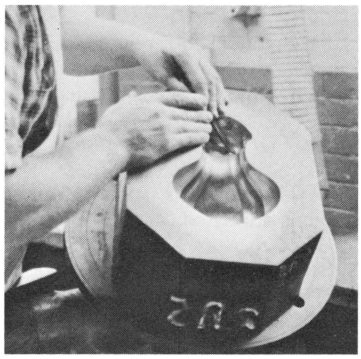
LEADING SILVER-MINING COUNTRIES

Silver mined in 1972

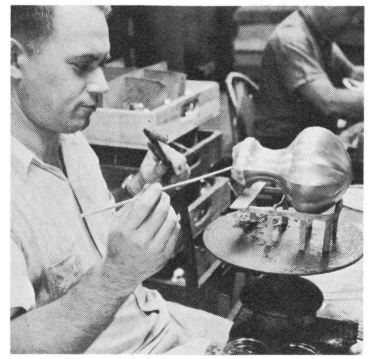
*Estimate.
Sources: U.S. Bureau of Mines; Statistics Canada.

HOW SILVER PLATE TABLEWARE IS MADE

The production of a piece of quality silver tableware may involve more than 40 steps. The process begins with an artist's design. Working from the design, a craftsman makes a steel tool called a *die*, which forms sheets of metal into desired shapes. The pictures below show some of the steps involved in making a teapot. After the body of the pot has been formed by the die, workers add the handle, spout, and other parts. The teapot then must be polished, cleaned, and inspected.



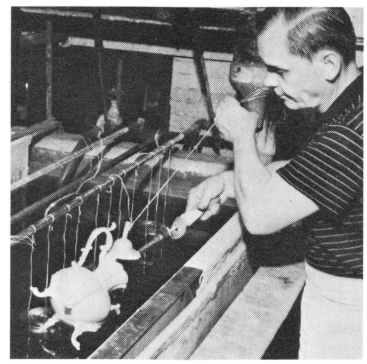
A Teapot Die is shaped by a die-cutter, above. A machine presses the die against metal sheets and forms half-teapots.



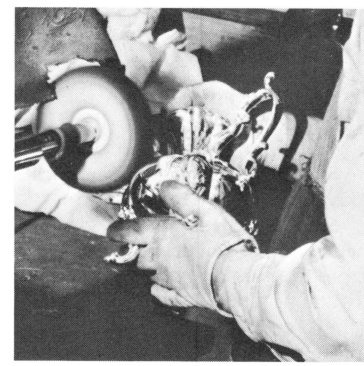
Soldering joins the halves of the teapots together with hot tin. Then the soldered seams are hammered to make them smooth.

The *Chasing* Operation adds decoration to some of the teapots. Other teapots receive no chasing.

Handles and Other Parts are cast in a mold separately. These parts must be carefully soldered to the teapot, above.



A Coating of Silver covers the teapot, which is made of a white metal alloy, and gives it the appearance of solid silver.



Reed & Barton

Polishing, above, brings out the silver's luster. The teapot is then washed and inspected before being packaged.

The leading silver-producing states of the United States include Arizona, Colorado, Idaho, and Utah. The chief silver-mining areas of Canada are in British Columbia, the Northwest Territories, Ontario, and the Yukon Territory. Silver mines may be close to the surface or deep in the earth. The metal is mined in the same way as other underground deposits of metal.

After they are mined, silver ores are usually reduced to a rich concentrate which in turn is *smelted* (a heat process). The product of the smelting is further refined to remove the metals associated with the silver.

Uses of Silver. Pure silver is too soft to stand up under constant wear. It is usually mixed with copper to form an *alloy* before it is made into commercial articles. This alloy is used to make coins, jewelry, and tableware. Silver coins in the United States used to be made of 90 per cent silver and 10 per cent copper. But in 1965, Congress passed a bill to eliminate all silver from new dimes and quarters, and to reduce the silver in new half dollars from 90 per cent to 40 per cent. Until the Coinage Act of 1920, British coins were 92½ per cent silver and 7½ per cent copper. The 1920 act reduced the silver content to 50 per cent. The 1946 Coinage Act eliminated all silver in British coins. They are now made of a copper-nickel alloy.

Sterling silver contains as much or more silver as British coins did. The word *sterling* has been used to mean high-quality silver since the 1200's. At that time, the English pennies called *sterlings* contained large proportions of silver. People throughout Europe considered these coins very valuable. Many sterlings had a star stamped on them, and the word *sterling* probably came from an old word for *star*.

Silver plate is made by coating base metals with pure silver or silver alloy by electrolysis (see ELECTROLYSIS). Silver plate does not wear so well as solid silver alloy, because the base metal shows through as the plate wears off. But silver plate is a good deal less expensive than solid silver, and is more widely used for tableware.

In the laboratory, silver has many uses. One of its most important chemical compounds is called *silver nitrate* or *lunar caustic*. This compound is made by dis-

solving silver in nitric acid. Silver nitrate is widely used in photography, silver plating, and indelible ink. *Silver chloride* is made by adding hydrochloric acid to a solution of silver. It is then combined with silver bromide for use in various chemical processes of photography.

Silver fulminate—which contains nitrogen, carbon, hydrogen, and oxygen in addition to silver—is a violent explosive. But its use in explosives has been largely displaced by mercury fulminate and other cheaper compounds. HARRISON ASHLEY SCHMITT

Related Articles in WORLD BOOK include:

Alloy
Amalgam
Bullion
Colonial Life in America (Crafts)
Dollar (picture)
Ductility
Money
Silver Nitrate
Western Frontier Life (The Search for Gold and Silver)

SILVER, ABBA HILLEL (1893-1963), was an American rabbi and Zionist leader. In 1917, he became rabbi of The Temple in Cleveland, Ohio, one of the largest Jewish Reform congregations in the United States. He helped promote the first unemployment insurance law in Ohio, as well as child labor laws.

Silver's principal writings include *Messianic Speculations in Israel* (1927), *The Democratic Impulse in Jewish History* (1928), *Religion in a Changing World* (1930), and *Vision and Victory* (1949). He was born in Neinstadt, Lithuania, and settled in the United States in 1902. He was graduated from the University of Cincinnati and Hebrew Union College. CLIFTON E. OLMSTEAD

SILVER CERTIFICATE. See MONEY (U.S. Money Today).

SILVER FISH is a small silver-colored insect with no wings. It is sometimes called a *silver fish moth*. This house pest is one of the most primitive insects. It has two long feelers, and three long appendages at the "tail" end. The silver fish eats anything with starch, paste, or glue on it. It can be controlled by dusting with pyrethrum powder (see PYRETHRUM).

Scientific Classification. Silver fish belong to the firebrat and silver fish family, *Lepismatidae*. They are genus *Lepisma*, species *L. saccharina*. ANTHONY STANDEN

SILVER FOX. See FOX; FUR.

SILVER NITRATE is a chemical used in medicine and industry. It burns the skin, and can cause severe poisoning or even death if swallowed. Doctors use silver nitrate to *cauterize* (burn) wounds to prevent bleeding or infection, and to remove warts. They use a mild solution of it to treat certain eye and skin diseases, and as an antiseptic. Some states require that the eyes of newborn infants be treated with silver nitrate solution to prevent possible blindness (see BLINDNESS [Diseases]).

The photographic industry uses silver nitrate in making film. Most silver salts used in film are manufactured from silver nitrate. For example, silver bromide photographic film is made from silver nitrate and a potassium bromide solution. Gelatin, a protein substance, is then added to the solution to form a substance called an *emulsion* which coats the film (see PHOTOGRAPHY [Developing Film]). Silver nitrate is also used to make mirrors and indelible ink, and in silver plating.

Silver can be purified by dissolving it in nitric acid and passing electricity through the silver nitrate solution. Pure silver forms at one electric terminal. Chemists use silver nitrate to help prepare other silver compounds, and also to identify chemicals in solution.

Manufacturers make silver nitrate by dissolving silver in nitric acid, and then evaporating the solution. They sometimes melt silver nitrate and allow it to harden into a crystalline mass. Silver nitrate in this form is also known as *lunar caustic*.

Silver nitrate has the chemical formula $AgNO_3$. It dissolves easily in water, and changes back into silver when it reacts with many metal and organic compounds. OTTO THEODOR BENFEY

SILVER PURCHASE ACT OF 1934. See MONEY (U.S. Monetary Standards).

SILVER STAR. See DECORATIONS AND MEDALS (United States Decorations and Medals).

SILVER STATE. See NEVADA.

SILVERED GLASS. See GLASSWARE (Mercury Glass).

SILVERSMITH. See COLONIAL LIFE IN AMERICA (Crafts); REVERE, PAUL; SILVER.

SILVERWARE. See NICKEL SILVER; SILVER (Uses).

SILVICULTURE. See FOREST AND FOREST PRODUCTS (Forest Management).

SIMCOE, JOHN GRAVES (1752-1806), was a British soldier and the first lieutenant governor of Upper Canada. He served from 1791 to 1797. During the Revolutionary War, he raised and commanded a corps of loyalists called the Queen's Rangers. Later, as lieutenant governor of Upper Canada, he helped found Toronto and settle loyalists who had fled from the United States. He was born in Cotterstock, England. W. B. WILLCOX

See also TORONTO (introduction; History).

SIMENON, *seem NAWN*, **GEORGES** (1903-), a French author, won fame for his detective stories about Inspector Jules Maigret of the Paris police force. Simenon wrote more than 500 novels and novelettes, of which about 75 deal with Maigret.

In most Maigret stories, Simenon emphasized the motives behind a crime more than the crime itself or the step-by-step detection of the criminal. He also concentrated on creating realistic characters. He became noted for his vivid descriptions of the people, sights, and sounds of Paris and the small towns of France.

Georges Joseph Simenon was born in Liège, Belgium. He became a newspaper reporter and published his first novel at the age of 17. By the age of 30, he had written about 200 novels and novelettes. Simenon published his first Maigret novel, *The Strange Case of Peter the Lett*, in 1929. His most-praised Maigret novels include *The Crime of Inspector Maigret* (1932) and *No Vacation for Maigret* (1953). HERBERT BREAN

SIMEON II. See BULGARIA (In World War II).

SIMHAT TORAH, *sim KAHT toh RAH*, is a Jewish festival of rejoicing in the Torah, or Law. It is the ninth day of Sukkot, and falls on the 23rd day of the Hebrew month of Tishri. Jews in Israel and Reform Jews observe it as the eighth day of Sukkot. Simhat Torah marks the end of the annual cycle of reading the Pentateuch in the synagogue. The cycle begins again on the first Sabbath after Sukkot. See also SUKKOT. LEONARD C. MISHKIN

SIMILE, *SIM uh lee*, is a figure of speech used in describing or explaining something. It points out a likeness between two different objects or ideas by using a connective word. This connective word is usually *like* or *as*. An example of a simile would be, "He is as cross *as* a bear today," or "She ran *like* a deer."

Often a simile becomes so compact that we drop the connecting word. Then the simile becomes a *metaphor*. For example, the simile "He is *like* a fox" becomes a metaphor in "He *is* a fox." JOSEPHINE MILES

See also FIGURE OF SPEECH; METAPHOR.

SIMON, NEIL (1927-), is an American playwright. His almost unbroken succession of hit comedies and musicals has made him the most commercially successful playwright in American theater history.

Marvin Neil Simon was born in New York City. His first plays were light, joke-filled comedies, beginning with *Come Blow Your Horn* (1961). He based *Barefoot in the Park* (1963) on his experiences as a newlywed in a Manhattan walk-up apartment. In *The Odd Couple* (1965), Simon explored more serious themes about relationships between people. This play concerns two men separated from their wives. The men set up housekeeping together but repeat the same mistakes that wrecked their marriages. *Last of the Red Hot Lovers* (1969) tells the adventures of a middle-aged husband who thinks modern society is experiencing a sexual revolution that has passed him by. In *The Prisoner of Second Avenue* (1971), a married couple tries to cope with the problems of living in a large U.S. city. THOMAS A. ERHARD

SIMON, WILLIAM EDWARD (1927-), became secretary of the treasury of the United States in 1974. President Richard M. Nixon had appointed Simon deputy secretary of the treasury in 1972. In December, 1973, Nixon named him administrator of the Federal Energy Office (FEO). Simon held both offices until his confirmation by the Senate as secretary of the treasury in May, 1974. In September, 1974, President Gerald R. Ford appointed Simon to an additional post, chairman of the Economic Policy Board. In that role, Simon served as Ford's chief advisor on economic policy.

As director of the FEO, Simon established policies to conserve the nation's available fuel and to develop long-range energy supplies. In 1973, after nearly every Arab country had stopped shipping oil to the United States, Simon helped develop a national gasoline rationing program for possible future use. He also urged Americans to save energy by using less heat and electricity at home and by driving at slower speeds.

Simon was born in Paterson, N.J. He graduated from Lafayette College in 1951 and joined a New York City brokerage firm in 1952. In 1964, he became a partner in one of the largest investment banking firms in the United States. GUY HALVERSON

SIMON FRASER UNIVERSITY is a coeducational university in Burnaby, B.C., a town east of Vancouver. It offers courses leading to bachelor's, master's, and doctor's degrees in arts, education, interdisciplinary studies, and science. The university was founded in 1963, and opened in 1965. It receives support from the provincial and federal governments, and private gifts. For enrollment, see CANADA (table: Universities and Colleges). PATRICK MCTAGGART-COWAN

SIMON PETER. See PETER, SAINT.

SIMON THE CANAANITE, SAINT, was one of the more obscure apostles of Christ. The word *Canaanite* does not mean *belonging to the land of Canaan*, but is the Hebrew or Aramaic word for the Greek *Zelotes*, or Zealot. He is called *Simon called Zelotes* in Luke 6:15. This name distinguishes him from Simon Peter.

Many authorities believe that Simon was called the Zealot because of his zeal for his work. But some believe the name might have indicated Simon belonged to a Jewish political party called *The Zealots*. This party advocated overthrow of the Roman government by violence and re-establishment of the independent Jewish state. Nothing certain is known of Simon's career after the beginning of the church, recorded in Acts 1:13. His feast day is generally celebrated as the feast of Saints Simon and Jude on October 28. However, the Eastern Orthodox Church celebrates the feast of Saint Simon on May 10. FULTON J. SHEEN and MERRILL C. TENNEY

SIMONIDES OF CEOS. See GREEK LITERATURE (Lyric Poetry).

SIMONS, MENNO. See MENNONITES.

SIMONT, MARC (1915-), is an American artist. He won a Caldecott award in 1957 for his illustrations in the book *A Tree Is Nice*, by Janice May Udry.

Simont was born in Paris, and grew up in France, Spain, and the United States. In 1948, he illustrated a new edition of Andrew Lang's *Red Fairy Book*. In 1950, Simont was a runner-up for a Caldecott award for his pictures in Ruth Krauss's book *Happy Day*. He also has done illustrations for newspapers, magazines, and folk tales. ELOISE RUE

SIMONY. See BARRATRY.

SIMOOM, *sih MOOM*, or SIMOON, is a hot dry wind that blows in the Sahara and the Arabian Desert. The simoom carries great clouds of sand and dust. It rises suddenly. Men and animals may suffer from heatstroke when they are exposed to a simoom. The simoom may pass in 10 minutes, or it may last for days. It leaves the desert in great drifts like snow after a blizzard. Simooms are caused by the overheating of the soil and the layers of air next to it. JAMES E. MILLER

SIMPLON PASS AND TUNNEL are important gateways through the Swiss Alps. Napoleon built a military road over the pass in the early 1800's. The present improved road leading to the pass begins at Brig in the Rhône Valley. It reaches an elevation of 6,592 feet (2,009 meters), then descends into the Lake District of northern Italy. The Simplon Tunnel, completed in 1906, is one of the longest railroad tunnels in the world. It is 12.3 miles (19.8 kilometers) long, and has a maximum elevation of 2,312 feet (705 meters). For location, see SWITZERLAND (color map). FRANKLIN CARL ERICKSON

SIMPSON, SIR GEORGE (1787?-1860), served as governor of the North American territories of the Hudson's Bay Company from 1826 to 1860. He helped make the company one of the world's greatest fur-trading firms.

During most of Simpson's term, the company's land included a large part of what are now Canada and the Pacific Northwest region of the United States. Simpson ranked as the company's top governing official and became known as the "Little Emperor" because of his firm rule. He established trading posts on the Pacific coast, developed friendly relations with the Indians, and aided Arctic explorations.

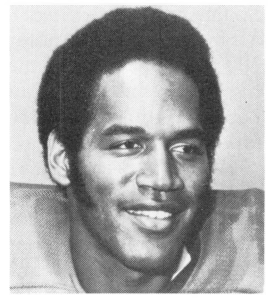
Simpson was born in Loch Broom, in what is now the county of Ross and Cromarty in Scotland. He settled in Canada after joining the Hudson's Bay Company in 1820. Simpson played an important part in uniting the firm with its rival, the North West Company, in 1821. Later that year, he became governor of

the company's northern territories. Simpson often made difficult journeys to inspect trading posts and forts. He was knighted in 1841. P. B. WAITE

See also HUDSON'S BAY COMPANY; NORTH WEST COMPANY.

SIMPSON, SIR JAMES YOUNG (1811-1870), a Scottish doctor, specialized in the problems of childbirth, or obstetrics. In 1847, he found in chloroform a substitute for ether, and was the first to suggest the use of this drug to relieve the pain of childbirth (see ANESTHESIA; CHLOROFORM). An argument followed the discovery. It ended in Simpson's favor when Queen Victoria gave birth to her eighth child, Prince Leopold, under chloroform. Simpson was born in Bathgate, Scotland. GEORGE ROSEN

SIMPSON, O. J. (1947-), ranks as one of the best runners in football history. Simpson, a halfback, became noted for his speed and ability to maneuver away from tacklers.



Buffalo Bills

O. J. Simpson

Simpson won all-America honors twice at the University of Southern California. In 1967, he led USC to the national championship. Simpson received the Heisman Trophy as the nation's outstanding college football player of 1968.

In 1969, Simpson joined the Buffalo Bills of the National Football League (NFL). He led the league in rushing during the 1972 and 1973 seasons. In 1973, he set a league record for most yards gained in a season (2,003). Orenthal James Simpson was born in San Francisco. BOB WOLF

SINAI, *SY ny*, is the mountain on which Moses received the *Decalogue* (Ten Commandments) and learned much of the Hebraic law. Mt. Sinai, also called *Horeb*, is located somewhere in the mountain district of the Sinai Peninsula, a triangle between the two north arms of the Red Sea. For the past 1,500 years, scholars have considered Mt. Sinai to be an 8,000-foot (2,400-meter) peak in the southern tip of the triangle. Today, many experts think it may be in the peninsula's northeastern part. See also MOSES. WILLIAM WILSON SLOAN

SINAI PENINSULA. See MIDDLE EAST (History).

SINALOA, *SEE nah LOH ah*, is a long, narrow Mexican state along the Gulf of California and the Pacific Ocean. For location, see MEXICO (political map). Sinaloa covers 22,429 square miles (58,091 square kilometers) from a broad coastal plain to the Sierra Madre Occidental Mountains in the interior. It has a population of 1,266,528. It is one of the chief agricultural states in Mexico. Culiacán is the capital and Mazatlán is a leading port (see MAZATLÁN). Sinaloa became a state in 1830. CHARLES C. CUMBERLAND

SINATRA, FRANK (1915-), ranks among the most famous singers in the history of popular music. Nicknamed "The Voice," he became well known for both his soulful ballad singing and his interpretations of rhythm songs. Since he made his motion-picture debut in 1941, he has appeared in more than 50 films. He won the 1953 Academy Award as best male supporting actor for his work in *From Here to Eternity*.

Francis Albert Sinatra was born in Hoboken, N.J., the son of a fireman. He sang with local bands and won an amateur show prize in 1937 before joining trumpeter Harry James' band in 1939. While touring with the band of trombonist Tommy Dorsey from 1940 to 1942, he gained great popularity with teen-agers throughout the United States. Sinatra began his career as a solo singer in 1943, and later gained popularity with audiences of all ages. LEONARD FEATHER

SINBAD THE SAILOR. See ROC; BASRA.

SINCLAIR, HARRY FORD (1876-1956), was an American oil producer and refiner. His vast holdings became the Sinclair Oil Corporation (now Atlantic Richfield Company). He was involved in the *Teapot Dome* oil scandal of 1923, but was found innocent of fraud (see TEAPOT DOME). He went to prison briefly in 1927 for contempt of the U.S. Senate during an investigation. Sinclair was born in Wheeling, W.Va. W. H. BAUGHN

SINCLAIR, UPTON (1878-1968), was an American writer and reformer. He became famous as a *muckraker*, a writer who exposed various social or political evils. Sinclair said his books had one theme: "the contrast of the social classes; there are characters from both worlds, the rich and the poor, and the plot is contrived to carry you from one to the other." His works are uneven in quality, perhaps because he was more interested in calling attention to issues than in creating works of art.

Sinclair is one of the most translated U.S. authors. His best-known novel, *The Jungle* (1906), exposed conditions in the meat-packing industry and led to passage of the nation's first pure food laws. In other novels and nonfiction, Sinclair attacked capitalistic society (*The Metropolis*, 1908), conditions in coal mines (*King Coal*, 1917), organized religion (*The Profits of Religion*, 1918), the press (*The Brass Check*, 1919), U.S. higher education (*The Goose Step*, 1923), and the oil industry (*Oil!*, 1927).

From 1940 to 1953, Sinclair published the Lanny Budd series of 11 novels, named for the principal character. These books reflect the world's concern at that time with Communism and fascism. The best-known novel of the series, *Dragon's Teeth* (1942), won the 1943 Pulitzer prize for fiction.

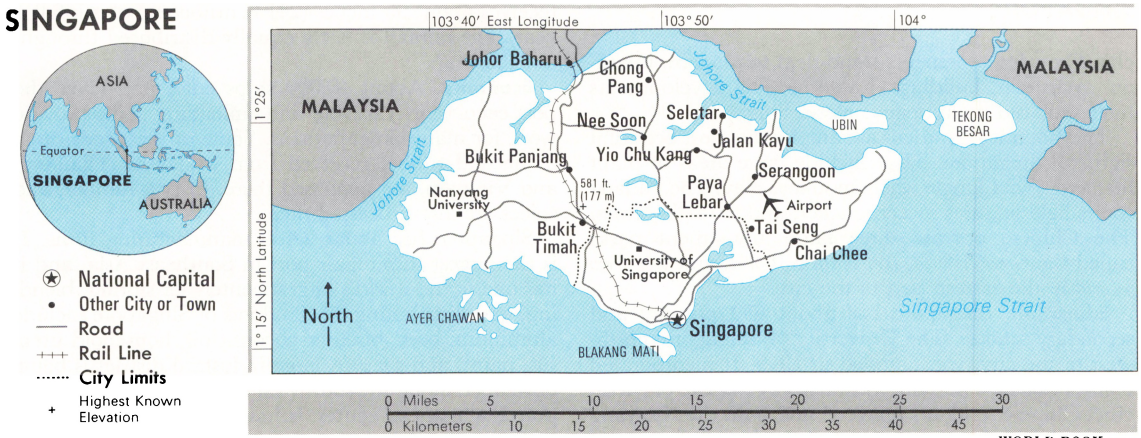
Sinclair also was an active social and political reformer. He helped organize the American Civil Liberties Union and the League for Industrial Democracy. He ran unsuccessfully three times each for Congress and for governor of California. Upton Beall Sinclair was born in Baltimore. DEAN DONER

SINE. See TRIGONOMETRY.

SINEW. See TENDON.

SINFONIA. See SYMPHONY.

SING SING was for many years the name of a state prison in Ossining, N.Y. In 1970, it was renamed the Ossining Correctional Facility. The prison is almost a city in itself, with its own school and factories. Whenever possible, the convicts are given prison jobs for which they are suited by their training and experience. The prison originally had a building for women. But the facility now has no women prisoners. Construction of the buildings began in 1825 with convict labor. Later the prison was reorganized, and several new buildings were put up. W. L. DENNO



WORLD BOOK map

SINGAPORE, *SING guh pohr*, is a small island country in Southeast Asia. It is about as big as the city of Chicago, and only one-fifth as big as Rhode Island—the smallest state in the Union. The country lies at the southern end of the Malay Peninsula. Singapore is separated from the island of Sumatra in Indonesia by the Strait of Malacca.

The bustling, crowded city of Singapore, on the southern end of the island, is the heart of the country. Most of the people live there, and the country's thriving economy is based on the city's business. Singapore city is a business and banking center, and one of the world's busiest ports. Ships from many countries stop there to load and unload cargo. Many Asian countries send copra, lumber, rubber, spices, and other goods to Singapore to be sorted, graded, and packed. Ships then carry the goods to other countries.

Great Britain controlled the island from 1824 to the mid-1900's. Singapore became part of the independent Federation of Malaysia in 1963, but was excluded from the federation and became an independent country in 1965. It joined the Commonwealth of Nations and the United Nations in 1965.

Government. Singapore is a republic. The president is elected to a four-year term by the Parliament. The president is head of state, and appoints the prime minister. The prime minister actually directs the government. The prime minister directs foreign and domestic policy and selects the 14 members of the *Council of Ministers* (cabinet). The people elect the 65 members of the Parliament.

The People. About three out of four Singaporeans are Chinese. The Chinese of Singapore are noted as good businessmen. They run most of the import trade and much of the country's other business. Some Chinese in Singapore work on farms. About 15 out of 100 persons are Malays. Many of the Malays work as fishermen, policemen, plantation laborers, or taxicab drivers. Most of the other people in the country are Indians, Pakistanis, and Europeans. The Europeans work mainly in trade and commerce. The official languages of Singapore are Chinese, English, Malay, and Tamil.

John F. Cady, the contributor of this article, is Distinguished Professor of History Emeritus at Ohio University and the author of Southeast Asia: Its Historical Development.

The City of Singapore has a population of 2,074,507 persons, or about 90 per cent of the country's total population. The city lies on the southern shore. It was built over hills that were leveled and marshes that had to be filled with earth.

The city's location and port facilities make it the major commercial and shipping center in Southeast Asia. Singapore is a gateway from India to the Far East. Ships sailing from India to China, Japan, and Australia stop at Singapore to load and unload cargo. The 36-square-mile (93-square-kilometer) harbor boasts the best facilities in Southeast Asia. Singapore is built around the harbor. Warehouses and concrete docks line the port. Singapore is a *free port*, which means that goods can be unloaded, stored, and reshipped without paying duty fees.

Much of Singapore city resembles large cities in the United States. Hotels and offices occupy skyscrapers in downtown Singapore. Department stores and shops in the city attract shoppers. A monument to Sir Stamford Raffles, the founder of Singapore, stands on Empress Place. Raffles Square lies near the waterfront.

Most of the people live in the western part of the

FACTS IN BRIEF

Capital: Singapore.
Official Languages: Chinese, English, Malay, and Tamil.
Official Name: Republic of Singapore.
Form of Government: Republic.
Area: 224 sq. mi. (581 km²). *Greatest Distances*—east-west, 27 mi. (43 km); north-south, 14 mi. (23 km). *Coastline*—60 mi. (97 km).
Population: *Estimated 1976 Population*—2,324,000; distribution, 84 per cent urban, 16 per cent rural; density, 10,360 persons per sq. mi. (4,000 persons per km²). *1970 Census*—2,127,031. *Estimated 1981 Population*—2,566,000.
Chief Products: *Agriculture*—coconuts, fruits, tobacco, vegetables. *Manufacturing and Processing*—copra products, rubber products, ships, spices, tin products.
National Anthem: "Majullah Singapura" ("Forward Singapore").
Flag: There are two horizontal stripes, red on top (for equality and brotherhood), white below (for purity and virtue). A white crescent and five white stars (for democracy, peace, progress, justice, and equality) lie in the upper left corner. See FLAG (color picture: Flags of Asia and the Pacific).
Money: *Basic Unit*—Singapore dollar.

city. Crowded tenements stand next to modern, luxurious apartment buildings. Large housing developments have replaced many tenements in Singapore city.

The Botanical Gardens are among the most beautiful sights of Singapore. They include large areas of plant life, and a wild jungle where monkeys play. The Padang sports field features soccer, cricket, and football games. The Chinese operate three large amusement parks called the *Great World*, the *Happy World*, and the *New World* in the eastern part of the city.

Education. Singapore has about 650 primary and secondary schools. The University of Singapore, northwest of the city, was founded in 1949. It incorporated Raffles College and King Edward VII College of Medicine. Chinese residents financed and built the Nanyang University in the western part of the island. It opened in 1956.

Land. Singapore covers 224 square miles (580 square kilometers). Except for a plateau in the center of the island, most of the land is low. The western and central sections of the island are hilly, and the east is flat.

Singapore Strait forms the island's southern coastline. In the north, the Johore Strait, only $\frac{3}{4}$ mile (1.2 kilometers) wide, separates the island from Johor, a state in Malaysia. A stone and cement *causeway* (bridge) carries railway tracks, a highway, and a pipeline across the Johore Strait. The pipeline carries fresh water to the island.

Singapore has a hot, moist climate. The average annual temperature is about 80° F. (27° C). The island receives about 95 inches (241 centimeters) of rainfall a year. The rainfall is fairly equally distributed throughout the year.

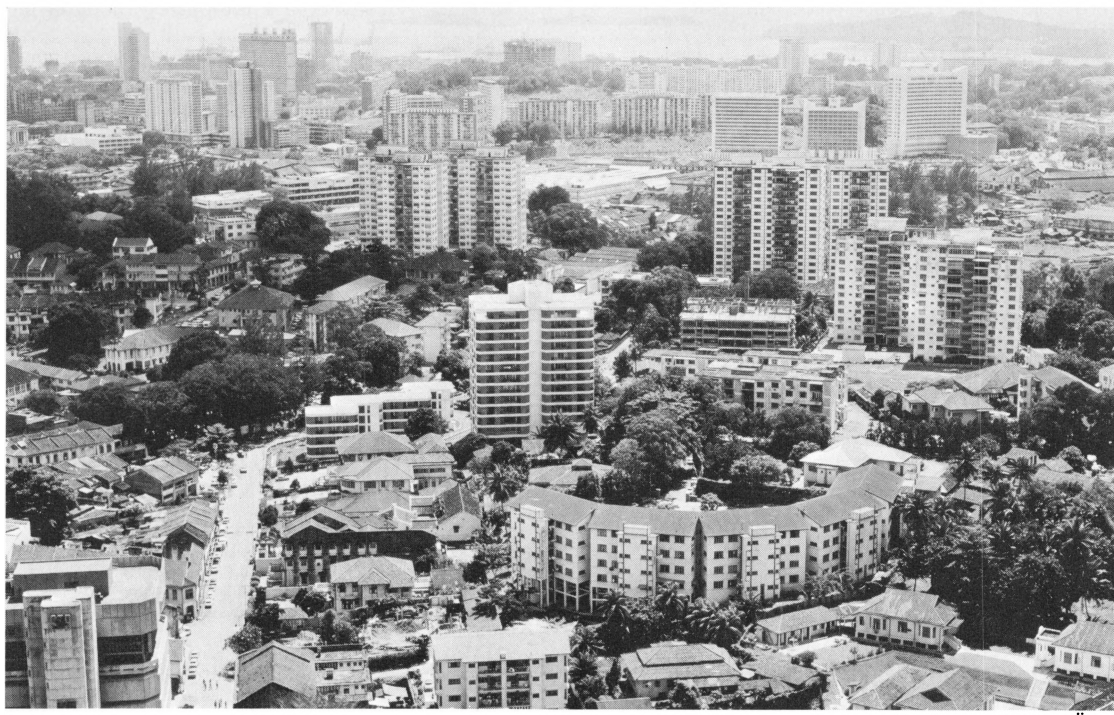
Economy. About 40,000 ships enter and leave the port each year. Loading and unloading ships provide work for many Singaporeans. Some of the goods, such as natural rubber received from Malaysia, Thailand, and Vietnam, are processed there. Copra, lumber, and spices are also processed there.

Singapore has about 2,400 manufacturing firms. It is the largest ship repair port in Southeast Asia, and it has one of the world's largest centers for storing, blending, and distributing oil. Products of Singapore include aluminum, beer, biscuits, coconut oil, household utensils, paint, and soap. A large industrial district is being developed along the southwest coast. The city of Singapore is a financial center. It has 35 banks.

The country imports most of its rice. Only a small portion of the land there is used for farming. Singapore produces about one-half of the fish and vegetables that its people eat. But it produces nearly all of the pigs and poultry used for food. Chinese gardeners raise fruits and vegetables on most of the cultivated land. Some rubber plantations lie in the northern section of the island, and coconuts grow in the sandy eastern part.

Singapore's 16 miles (26 kilometers) of railroad are linked to Kuala Lumpur, Malaysia; and Bangkok, Thailand. Most of the 525 miles (845 kilometers) of roads on the island are paved. Airlines use the Paya Lebor airport, east of the city.

History. Historians know little of the early history of Singapore. In the 1200's and 1300's, Singapore har-



Kay Honkanen from Carl Östman

The City of Singapore lies on the southern coast of the island of Singapore. It is a thriving business and financial center and also ranks as one of the world's busiest ports. Since the mid-1900's, modern apartment and office buildings have been built in many parts of this crowded city.

bor (then called Tumasik) was a fairly important trading center. Invaders from the island of Java (now part of Indonesia) destroyed Tumasik in 1377. The port of Melaka was founded north of Singapore about 1409. Singapore then lost its commercial importance.

In the early 1800's, Singapore was a jungle-covered island, with only a fishing village on the southern coast. Sir Stamford Raffles, an agent for the British trading organization called the East India Company, recognized the potential importance of the island to British trade. In 1819, he gained possession of Singapore harbor for Britain through an agreement with a sultan of Johor. The entire island came under British control in 1824 by agreement with the Dutch. In 1826, Singapore became part of the Straits Settlements, a British colony (see STRAITS SETTLEMENTS). Emigrants from China poured in to become traders and workers.

The British built a huge naval and air base on the northern shore of the island during the 1930's. They installed strong defenses, cut airfields out of the jungle, and placed submarine nets across the harbor entrance. Singapore was called the *Gibraltar of the East*. But the British prepared only for attack from the sea. Early in World War II, Japanese troops marched down the Malay Peninsula from Thailand and easily took Singapore. They occupied the city from 1942 to 1945.

The British dissolved the Straits Settlements in 1946, and made Singapore a separate crown colony. Small islands surrounding the main island, and Great Britain's Christmas Island south of Java, were administered from Singapore. Christmas Island was transferred to Australia in 1958.

The people of Singapore elected their first representative legislature in 1955, and some of them began to ask for complete independence about the same time. In October, 1957, the legislature passed a bill which made all people who had lived in the colony eight years citizens of Singapore. Singapore gained internal self-government on June 3, 1959. Britain was responsible for Singapore's defense and foreign affairs.

The territories of Singapore, Sabah (formerly North Borneo), and Sarawak (also in Borneo) joined Malaya in forming the Federation of Malaysia on Sept. 16, 1963. Many social and political differences existed within the federation. When Singapore's Chinese leadership threatened to upset the balance in the federation, the Malaysian government excluded Singapore in 1965. Singapore became an independent country.

The island controls its own defense and foreign affairs. Lee Kuan Yew, a lawyer, became the first prime minister of the country. JOHN F. CADY

See also MALAYSIA (History).

SINGAPORE (pop. 2,074,507) is the capital of the country of Singapore. The city has one of the busiest ports in the world. The city is described under SINGAPORE (the country). JOHN F. CADY

SINGER, ISAAC BASHEVIS (1904-), is a Polish-born author who writes in Yiddish. The son of a rabbi, he was educated in a rabbinical seminary, and his Jewish education forms the basis of his writing.

Singer is primarily a storyteller. His best-known tales are romantic or legendary rather than realistic. The narrators in some of his stories are imps or demons. Many of Singer's works combine modern realism with Jewish folklore and fantasy.

Singer grew up in a poor section of Warsaw. He moved to the United States in 1935. Many of his works first appeared in the *Jewish Daily Forward*, a Yiddish newspaper published in New York City, and were later translated into English. He is best known for his short stories, collected in *Gimpel the Fool* (1957), *The Spinoza of Market Street* (1961), *Short Friday* (1964), and *A Friend of Kafka* (1970). Singer shared the 1974 National Book Award prize for fiction for his collection *A Crown of Feathers* (1973).

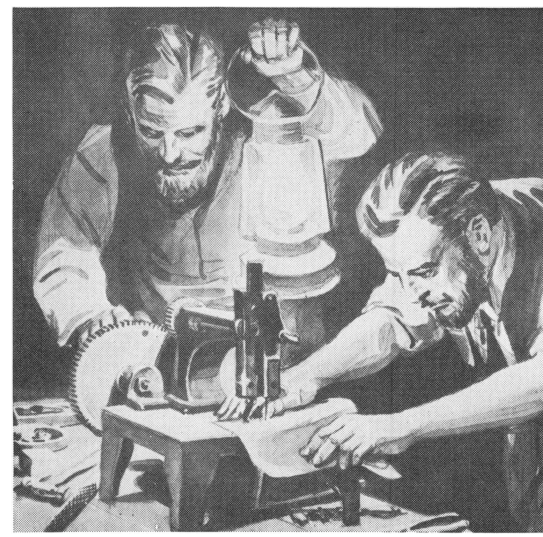
Singer's novels include *Satan in Goray* (1935), *The Family Moskat* (1945), *The Magician of Lublin* (1960), and *The Slave* (1962). A long work serialized between 1952 and 1955 was published as two related novels, *The Manor* (1967) and *The Estate* (1969). Singer's *A Day of Pleasure: Stories of a Boy Growing Up in Warsaw* (1969) won the 1970 National Book Award prize as the best children's book of the year.

Isaac's brother, Israel Joshua Singer (1893-1944), was also a noted Yiddish author. His best-known work is the novel *The Brothers Ashkenazi* (1936). JOSEPH N. RIDDEL

SINGER, ISAAC MERRIT (1811-1875), more than any other man, made the sewing machine a universal household appliance. When a crude sewing machine was brought to him for repairs in 1851, his skill as a machinist led him to see how it could be made an efficient, versatile, and salable device. Unaware of Walter Hunt's and Elias Howe's work on the sewing machine, Singer hit on solutions similar to theirs (see HOWE, ELIAS).

In 1854, the courts awarded basic patent rights to Howe, after a hard-fought trial. Then Singer organized sewing machine manufacturers into the first patent pool in American industry. The pool permitted seven leading companies to share the best features of the sewing machine.

By his energetic promotion and keen business sense, Singer acquired $13 million. He was the first man to spend a million dollars a year on advertising. Singer



Singer Manufacturing Co.

Isaac Merrit Singer developed a better sewing machine in 1851 and later took out 20 patents for additional improvements.

was born in Oswego, N.Y. He became a mechanic at the age of 12. RICHARD D. HUMPHREY

See also SEWING MACHINE.

SINGING is as much a natural function of the human voice as speaking is. We speak for practical purposes, in order to convey our thoughts. We sing for joy from early childhood and, through the songs we learn later, to express emotions. The spontaneous singing of young children and the humming of adults may occur without any cultivation of the voice or technical training. But the singing of songs and of more elaborate music in front of an audience requires study and training.

How We Sing. When we want to sing, nerve centers near the brain cause the vocal cords to start vibrating. The energy of the air stored in our lungs amplifies this vibration to make it audible. Small modifications in the length and width of the vocal cords produce different pitches and also musical phrases. An average untrained voice can sing 12 notes, which is the range of most popular songs. Well-trained voices can cover two octaves, or 16 notes. Some unusual voices, after much training, have been able to cover three octaves.

Voice Classification. Voices are classified by their range and by their *timbre* (tone color). The highest woman's voice is the *soprano*. Below it is the *mezzo-soprano*, and next the *contralto* (or *alto*). The highest man's voice is the *tenor*, then the *baritone*, and below it the *bass*.

Training the Voice. Most people can be taught to sing at least simple melodies. With the help of microphones, talented singers of popular songs have made successful careers with voices of average power and range. But to become an opera star or a concert recitalist requires a voice of unusual power, range, and quality. Some arias include very high and very low notes; the performer may have to sing many words without taking a breath; the voice may have to rise above powerful orchestrations; or perhaps the performer must sing quite softly for a long time. An opera singer must be able to sing through the entire length of an opera (sometimes for more than three hours) and to sing another opera two days later. Many young persons try to become singers, but only a few succeed in achieving the excellency necessary to become a successful opera and concert singer.

Al Kaplan, DPI

Choral Singing is a popular activity in many schools. Most mixed choruses consist of the four common singing voices—soprano and alto for females and tenor and bass for males.

The training of the voice for professional singing takes patience and practice. A voice student must learn to know and discipline many things in himself, including the way he stands, the posture of his body, the depth and ease of his air intake, and the relaxation of his neck and upper chest. The singer must also control the energy created by the large quantities of air in his lungs, and must use this for sending tones into the resonances of the head without making his throat tense and tired. Low notes should sound near the lips; high notes, in the cavities above the bone of the palate. The breath support must be able to back low tones or spin soft ones. The singer does this by regulating smoothly the muscles of his lower chest and upper abdomen.

The singer must learn to express the gamut of human feelings. He must study music, because the human voice at its best is a beautiful musical instrument.

Song sheets often indicate how to sing. For example, they sometimes have *mezza di voce* printed in certain places. This means that, at such a point, the voice must increase the tone gradually from *pianissimo* (very soft) to *fortissimo* (very loud), and then back again. Another term, *legato*, means to sing smoothly.

The student usually begins by singing scales on pure vowels. Then he switches to words and phrases, and finally to entire songs. The singer must remember that the words he sings must be clearly understood. Singing clear and precise vowels, and connecting them with crisp, light consonants will improve the enunciation more than any exaggerated effort of the mouth to project the diction. Persons training for public singing are advised to work on Italian songs and arias, because the precision of Italian vowels helps the voice attain beauty and freedom. MARTIAL SINGHER

Related Articles in WORLD BOOK include:

AMERICAN OPERA SINGERS

Anderson, Marian
Callas, Maria
Farrar, Geraldine
Garden, Mary
Hayes, Roland
London, George
Maynor, Dorothy
Peerce, Jan
Ponselle, Rosa Melba
Price, Leontyne
Robeson, Paul
Sills, Beverly
Tucker, Richard

ITALIAN OPERA SINGERS

Caruso, Enrico
Galli-Curci, Amelita
Martinelli, Giovanni
Tebaldi, Renata
Tetrazzini, Luisa

SCANDINAVIAN OPERA SINGERS

Bjoerling, Jussi
Flagstad, Kirsten
Lind, Jenny
Melchior, Lauritz L. H.
Nilsson, Birgit

OTHER OPERA SINGERS

Chaliapin, Feodor I.
Fischer-Dieskau, Dietrich
García (family)
Lehmann, Lilli
Lehmann, Lotte
Malibran, Maria Felicita
McCormack, John
Melba, Nellie
Patti, Adelina
Reszke (family)
Schumann-Heink, Ernestine
Schwarzkopf, Elisabeth
Sutherland, Joan

POPULAR SINGERS

Baez, Joan	Durante, Jimmy	Ives, Burl
Beatles	Dylan, Bob	Jolson, Al
Belafonte, Harry	Fitzgerald, Ella	Lauder, Sir Harry
Burleigh, Harry Thacker	Garland, Judy	Russell, Lillian
Cantor, Eddie	Guthrie, Woody	Seeger, Pete
Cohan, George M.	Holiday, Billie	Sinatra, Frank
Crosby, Bing	Horne, Lena	Waters, Ethel

OTHER RELATED ARTICLES

Alto	Music
Aria	Musical Comedy
Barbershop Quartet Singing	National Anthems
Cantata	Opera
Chorus	Operetta
Folk Music	Oratorio
Glee Club	Song
Hymn	Voice
Minnesinger	Westminster Choir
Monophony	Yodel

SINGING TOWER is a beautiful tower, 205 feet (62 meters) high, which stands in a 50-acre (20-hectare) park at Mountain Lake, Fla. It contains one of the biggest sets of *carillons* (bell chimes) in the world. Edward Bok built it as a gift to the American people. The park is a bird refuge. Milton B. Medary designed the tower, and Samuel Yellin made the brass doors and iron railings. Two marble bridges span the moat around the tower. Mountain Lake is near Lake Wales, in central Florida. See also BOK, EDWARD W. G. HOLMES PERKINS

SINGLE-ENTRY BOOKKEEPING. See BOOKKEEPING (Kinds of Bookkeeping).

SINGLE TAX is a type of property tax. The term is usually applied to a system of land taxation supported in the late 1800's by Henry George, an American social reformer. The system was never put into general use.

Henry George said that a tax on land should be the only source of money for the government. He believed that landowners receive all the wealth from the use of their land. But the landowners do nothing to earn the wealth. A small plot of rocky soil on the point of Manhattan Island is worth a fortune solely because millions of people are crowded into a small area in New York City. This increased value of land is due not to the owner's effort but to population growth and other factors beyond his control. It is called *unearned increment.*

Single taxers argue that since the whole population gives the land its value, the whole population should share it. They urge that the government should, by taxation, take the entire unearned increment from land and use it for the public good. CHARLES J. GAA

See also GEORGE, HENRY.

SINHALESE. See SRI LANKA (People).

SINK, in geology, means a large sunken place in the earth, especially a lake which has no outlet.

SINKIANG, *sihn kyang*, is a region in western China that shares a 2,000-mile (3,200-kilometer) border with Russia (see CHINA [political map]). The Chinese government rules Sinkiang but calls it a self-governing region. China tests its nuclear weapons there.

Sinkiang is a desolate, thinly populated land of deserts and mountains. It covers about 17 per cent of China's land but has only about 1 per cent of the country's population. Most of Sinkiang's 8,500,000 persons live in oases at the edges of the region. They farm or herd for a living. A majority of the people are non-Chinese in origin. Turkic people called Uigurs make up about 75 per cent of the population. Other groups include Kazakhs and Kirgiz.

Urumchi, Sinkiang's capital, has factories that make farm machinery and cement. Farmers in Sinkiang grow corn, rice, and wheat, and herdsmen raise cattle, goats, sheep, and other animals. Mineral resources include coal, iron ore, oil, and uranium. A railroad links Urumchi with eastern China.

China first ruled Sinkiang during the Han dynasty (202 B.C.-A.D. 220). After periods of Uigur and Mongol rule, Sinkiang came under Chinese control again during the Manchu dynasty (1644-1912). In 1884, China made it a province. The Chinese Communists have ruled Sinkiang since 1949. Border disputes with Russia caused tension there in the 1960's. RICHARD H. SOLOMON

See also TURKESTAN.

SINN FÉIN, *shin fayn*, was an Irish nationalist society that favored an independent Irish republic, and played an important part in achieving it. The Gaelic words mean *we ourselves* or *ourselves alone.* Arthur Griffith formed the society in 1905. The Sinn Féin urged that the Irish refuse to pay taxes, to sit in Parliament, to serve in the armed forces, or to abide by court decisions. By 1915, Sinn Féin had won support among the Irish people. In 1916, the society led an uprising in Dublin during the Easter season. The British suppressed the so-called "Easter Rebellion," but this added to the popularity of the Sinn Féin. Two years later, it organized an Irish national assembly, the Dáil Éireann (pronounced *dawl AIR un*). The leaders of the assembly were Michael Collins and Eamon de Valera.

In 1922, the British Parliament established the Irish Free State in southern Ireland as a dominion within the British Commonwealth. In 1926, a majority of Sinn Féin followed De Valera in the formation of a separate party, the *Fianna Fáil* (Soldiers of Destiny), which entered the British-controlled assembly (*Dáil Éireann*). The Sinn Féin, as a separate party, lost much political influence. Fianna Fáil won government control in 1932. By 1948, Ireland was established as an independent republic (Éire). CHARLES F. MULLETT

See also DE VALERA, EAMON; IRELAND (History).

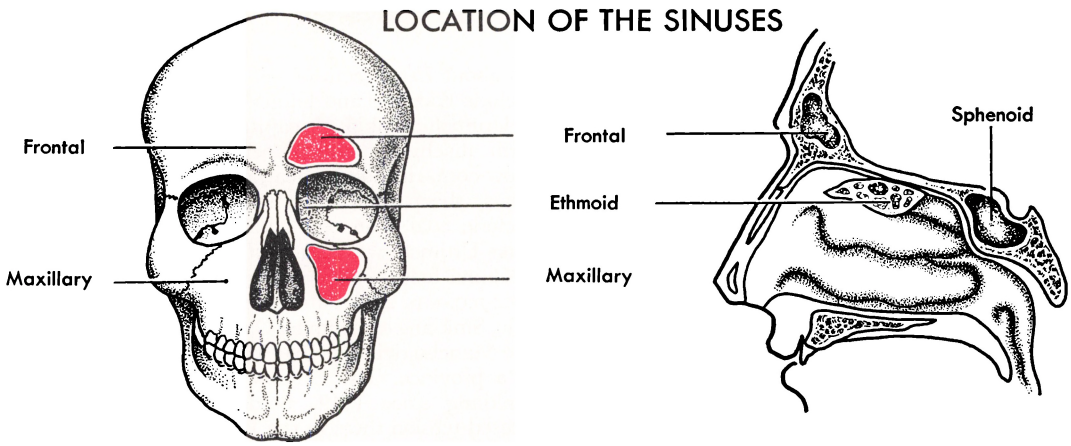
SINO-JAPANESE WARS. See CHINESE-JAPANESE WARS.

SINO-TIBETAN LANGUAGES. See LANGUAGE (Other Language Families).

SINTERING is the process of making metal parts from powdered metals. The powdered metals are pressed together in a die. Sintering gives parts special characteristics, such as heat resistance, heaviness, and hardness, that cannot be obtained by other methods. It is used to make bearings, gears, and similar parts.

SINUIJU, *SHIHN ee joo* (pop. 500,000), is a major industrial city in North Korea. It ranks second only to Pyongyang, the capital, in North Korean textile production. Sinuiju also serves as an important center of commerce, lumber, and mining. Its industries produce chemicals and electrical equipment.

Sinuiju lies on the Yalu River. For location, see KOREA (map). Bridges link Sinuiju with the Chinese city of Tan-tung across the river. Railroads connect Sinuiju with major North Korean cities and with China and Manchuria. WILLIAM E. HENTHORN



SINUS, *SYE nus,* is a cavity in the front of the skull. Humans have four groups of sinuses. Doctors sometimes call these groups the *paranasal* sinuses, because they all connect with the nasal cavity. Each group of sinuses takes its name from the bones of the skull in which it is found.

The *frontal* sinuses are in the frontal bone of the forehead just above the eyes. The *maxillary* sinuses, largest of the paranasal sinuses, are located in the cheekbones on each side of the nose. The *ethmoid* sinuses lie just above the nasal cavity, and the *sphenoid* sinuses are behind them. If the front of the skull were solid bone, the face would be very heavy and would tend to rest on the chest. The sinuses lighten the skull, and make it easier to hold up the head and to balance it on the neck.

The sinuses are lined with the same kind of membranes as those that line the nose (see MEMBRANE). Infections of the nose spread easily to the sinuses. There, the infection causes a disease commonly called *sinus trouble,* or *sinusitis.* In sinusitis, the inflamed mucous membranes in the sinuses become swollen, closing the opening and preventing infected material from draining out. When this happens, painful pressure builds up in the sinuses. This pain may occur at the same time every day. Other symptoms of a sinus ailment may include dizziness and a running nose. Allergies, colds, influenza, and many other diseases often result in sinus trouble. Other factors that may make certain individuals more susceptible to sinusitis include climate, dampness, drafts, and smoking.

The treatment of sinus trouble includes rest and liquid diet. Pain-relieving drugs are helpful. Sometimes surgery may be used to puncture a maxillary sinus and permit proper drainage. Sinus trouble is dangerous because it may serve as a center of infection that spreads to other parts of the body, such as the eye or brain.

Sinuses occur only in mammals, birds, and crocodiles. The huge sphenoid sinus of the elephant extends to the very back of the skull. WILLIAM V. MAYER

See also COLD, COMMON; HEAD; HAY FEVER.

SINUSOIDAL PROJECTION. See MAP (picture: Kinds of Map Distortion).

SINYAVSKY, ANDREY. See RUSSIAN LITERATURE (The 1950's and 1960's).

SIOUAN. See INDIAN, AMERICAN (Language Groups).

SIOUX CITY, Iowa (pop. 85,925; met. area 116,189), is a livestock market and an important wholesale distributing center for northwestern Iowa, northern Nebraska, and South Dakota. Sioux City lies on the east side of the Missouri River below the mouth of the Big Sioux River. It lies about 100 miles (160 kilometers) northwest of Omaha (see IOWA [political map]).

Sioux City covers an area of about 52 square miles (135 square kilometers). The city has 42 parks. Morningside College and Briar Cliff College are among the city's schools.

Sioux City claims to have the largest creamery in the United States, the largest honey-packing plant, the largest popcorn company, and the largest manufacturer of wind-propelled electric generators. Other products that come from Sioux City include meat products, automobile parts, building materials, furniture, leather goods, farm machinery and tools, livestock serums, and electrical and television supplies.

John K. Cook, who surveyed northwestern Iowa for the federal government, laid out the town in 1854 and named it for the Sioux Indians who lived in the region. During its early years, the town served as an outfitting place for prospectors hunting gold in the Black Hills. It was also a government post from which expeditions were sent out against hostile Indians.

In 1880, when the population was 7,366, Sioux City began to grow at a faster rate than any other U.S. city. By 1890, the population numbered 37,806.

Sioux City has a council-manager government. It is the seat of Woodbury County. For the monthly weather in Sioux City, see IOWA (Climate). WILLIAM J. PETERSEN

SIOUX FALLS (pop. 72,488; met. area 95,209), is the largest city and leading commercial and livestock center in South Dakota. Sioux Falls lies at the falls of the Big Sioux River. Its products include packaged meats, processed dairy foods, fabricated steel, millwork, high-altitude balloons, crushed rock, and electromagnetic equipment. Sioux Falls was first settled in 1856. Indians drove the settlers out in 1862, but the site was soon settled again. Sioux Falls is the home of Augustana College, Sioux Falls College, Johnson Memorial Hospital for Veterans, a state school for the deaf, and the state prison. It has a commission government. For the monthly weather in Sioux Falls, see SOUTH DAKOTA (Climate). EVERETT W. STERLING

SIOUX FALLS COLLEGE. See UNIVERSITIES AND COLLEGES (table).

SIOUX INDIANS, *soo*, once roamed through the northern plains of North America. They became famous for their bravery and their fighting ability. The Sioux called themselves *Dakota* or *Lakota*, meaning *allies*. They had many divisions. The Santee Sioux lived in what is now Minnesota. The Yankton Sioux lived in the eastern Dakotas. Both of these groups farmed and hunted. The Teton Sioux hunted buffalo west of the Missouri River.

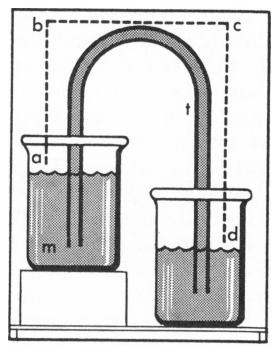
During the middle and late 1800's, white settlers and gold seekers overran Sioux hunting grounds and killed many buffalo. The Santee rebelled in 1862 and fled westward. In 1868, the Teton agreed to live on reservations. But they had no experience in farming, and their land was poor. Crazy Horse and Sitting Bull led groups that broke out in 1876. When Colonel George Custer marched against them, they killed every man in his immediate command in "Custer's Last Stand." Troops forced them to return to their reservations. In 1890, the Ghost Dance cult, introduced by Wovoka, brought new hope to the Sioux (see WOVOKA). Army leaders thought that the Indians meant to revolt, and attacked them. See INDIAN WARS (The Sioux Wars).

Most Sioux now live on reservations, and make a living as farmers and cattlemen. In 1973, a dispute over tribal leadership broke out among the Oglala Sioux of the Pine Ridge Reservation in South Dakota. The Oglala form one of the Teton Sioux bands. Partly as a result of the dispute, a group of Indians seized the village of Wounded Knee on the reservation and occupied it for 71 days. See SOUTH DAKOTA (South Dakota Today). BEATRICE MEDICINE

See also CRAZY HORSE; GALL; RED CLOUD; SITTING BULL; SPOTTED TAIL; INDIAN, AMERICAN (illustration: Indian Ways of Life; picture: Sun Dance).

SIPHON. See CLAM; GOEDUCK; OCTOPUS.

SIPHON, *SY fuhn*, is a simple device for carrying a liquid from one level to a lower level. It consists of a hose or a tube bent so that one side is longer than the other. To begin working, the siphon must first be entirely filled with a liquid. If the short side of the siphon is then placed in a container of liquid, the liquid will flow up the short side of the tube and down and out the long side.



Siphon

The illustration with this article shows a siphon arrangement. The siphon works because of differences in pressure. The weight of the liquid in the long side of the siphon, *cd*, reduces the pressure in the tube, *t*. Atmospheric pressure on the surface of the liquid, *m*, then forces liquid up the short side of the siphon, *ab*. After the liquid reaches the top of the siphon, gravity pulls it down the long side and the siphoning action continues. The siphon will work only until the liquid in both containers has reached the same level. Then, both sides of the siphon hold the same weight of liquid and the motion of the liquid stops. The siphon also stops working if its short side is pulled above the surface of the liquid. Air then rushes into the tube and the siphon empties without drawing any more liquid into it. OTTO A. UYEHARA

SIPHONAPTERA is an order of wingless insects that live as parasites on man and animals. This group includes fleas, chigoes, and chiggers. All insects of this order have mouth parts that can pierce the skin and suck blood. Many transmit serious diseases such as bubonic plague and typhus fever. See also FLEA; CHIGOE; CHIGGER; INSECT (table).

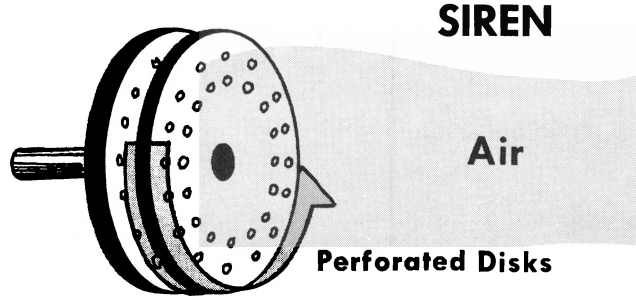
SIPLE, *SYE p'l*, PAUL ALLMAN (1908-1968), was an American Antarctic explorer and geographer. While a Boy Scout, Siple was a member of Richard E. Byrd's first Antarctic expedition in 1928. He headed the biology department on the second Byrd expedition from 1933 to 1935, and was geographer for the United States expedition from 1939 to 1941. In 1942, he joined the Department of War (now the Department of the Army). Siple went on major U.S. expeditions from 1946 to 1957, and was scientific leader of the South Polar Station in 1956 and 1957. He was scientific attaché at the U.S. embassy in Australia from 1963 to 1966. Siple was born in Montpelier, Ohio. JOHN EDWARDS CASWELL

See also ANTARCTICA (picture: The Geographic South Pole).

SIQUEIROS, DAVID. See LATIN AMERICA (Painting; picture: Colorful Mexican Murals); MEXICO (picture: The Story of the Mexican Revolution).

SIRACUSA. See SYRACUSE.

SIREN



SIREN is a device used to sound warning signals. Ambulances, fire trucks, and police cars use sirens to alert traffic. Sirens called *foghorns* are used on lighthouses and ships to warn other ships away during foggy and other bad weather. Sirens are also used for air-raid warnings.

One type of siren has two cylinders, one inside the other. The cylinders are *perforated* (punched with holes). This type of siren makes its sound when the outside cylinder revolves around the inner cylinder, and air is forced through the holes. An electric motor turns the cylinder in sirens on police cars, fire trucks, and other vehicles. When the holes in the cylinders are lined up, puffs of air escape and cause vibrations. As the cylinder is turned faster, the puffs become more frequent and produce a wailing sound. Some sirens have perforated disks instead of cylinders, and some of these can be turned by hand.

A newer type of siren produces its wailing sound

electronically. It has no moving parts, and does not wear out as quickly as older types. PAUL J. SCHEIPS

See also CIVIL DEFENSE (picture: A Warning Siren).

SIREN was the name given to some sea nymphs who lived on an island. According to Greek mythology, their singing drew sailors to their shores. The men would forget home and friends, and at last starve to death. In some stories, the Sirens would die if someone sailed past unmoved by their song. Ulysses put wax in his sailors' ears so they could not hear the song. Then he had them tie him to the mast. Ulysses listened to the Sirens, but could not go to them. The Sirens killed themselves because they had failed. PADRAIC COLUM

See also ODYSSEY (picture); ULYSSES; CAPRI.

SIRENIA, *sy REE nih uh*, is the name of an order of water mammals. The two living families are the dugongs and manatees (see DUGONG; MANATEE). The name *Sirenia* came from an old belief of seamen that dugongs and manatees were sirens or mermaids. Sirenians live in the shallow waters along tropical seacoasts and in lagoons, swamps, and rivers. They feed on aquatic plants. Sirenians are becoming rare because their rate of reproduction is slow and man kills more of them for meat than are born. Scientists know little about their origin or how they are related to other mammals. See also SEA COW. KARL W. KENYON

SIRHAN, SIRHAN B. See KENNEDY, ROBERT F.

SIRICA, JOHN J. See WATERGATE.

SIRIUS. See SHIP (Oceangoing Steamships).

SIRIUS, or the DOG STAR, is the brightest star in the heavens excluding the sun. It is one of the stars nearest to earth, but is still so far that its light takes nearly 9 years to reach earth. The Dog Star can be seen by looking along an imaginary line pointing southward through Orion's belt. It is the head of the constellation Canis Major, the Great Dog.

Sirius is a star of the first magnitude and radiates about 30 times as much light as the sun. Astronomers discovered its companion star in 1862. This star's gravity explained the fact that Sirius seemed to move in a wavy line. The two stars move around each other as they travel through space. The companion star is one of the most remarkable stars in the sky because the material in it is 50,000 times as heavy as water. Material from this star would weigh about 1,500 short tons per cubic foot (48,100 metric tons per cubic meter) if brought to the earth's surface. The Dog Star's companion was the first *white dwarf* star discovered. Many more white dwarfs have since been found, some with densities 500,000 times that of water. The great density of Sirius' companion is believed to be caused by the stripping of electrons from its atoms, which are packed tightly together. CHARLES A. FEDERER, JR.

See also CANIS MAJOR; DOG DAYS.

SIROCCO, *sih RAHK oh*, is the Italian name for two different types of southeast winds. They occur frequently in countries on the north side of the Mediterranean Sea. Both winds are warm because they come from warm regions. But one is a damp wind that usually comes before a rain, while the other is dry and carries desert dust from the Sahara. When the dry sirocco blows, fine sand darkens the sky. It burns the skin and parches the throat. It is similar to, but less violent than, the simoom of the desert. The term *sirocco* is now applied to certain other unseasonably warm winds. VANCE E. MOYER

SIRUP. See CORN (Uses); MAPLE SYRUP; MOLASSES; SORGHUM; SUGAR (Corn Sugar and Syrup).

SISAL, *SY sul*, or *SIHS ul*, is the name for two tropical plants with swordlike leaves that yield a valuable fiber. These plants, *henequen* and *sisalana*, produce fibers 20 to 50 inches (51 to 130 centimeters) long, which are used chiefly to make binding twine. Sisalana produces much stronger fiber than henequen. Henequen is raised in Cuba and Mexico, and sisalana in eastern Africa, Brazil, Haiti, and Java. Sisal is also called *sisal hemp*.

Sisal is harvested once or twice a year. The leaves are cut and fed into a *decorticator*, a machine that removes the pulp from the fiber. About 100 pounds (45 kilograms) of leaves produce 4 pounds (1.8 kilograms) of fiber. Eastern Africa is the leading producer of sisal.

Scientific Classification. Sisal is in the agave family, *Agavaceae*. Henequen is genus *Agave*, species *A. fourcroydes*. Sisalana is *A. sisalana*. EDWIN O. COGAN

See also ROPE.

SISERA. See MOUNT TABOR.

SISKIN, PINE. See PINE SISKIN.

SISLEY, ALFRED (1839-1899), was an impressionist artist best known for his landscape paintings. Sisley captured a variety of moods in his landscapes, ranging from cheerfulness to melancholy. His best pictures are delicately painted and reveal a more spacious, airy feeling than those of his fellow impressionists. Sisley particularly excelled in portraying snowy and misty scenes. See IMPRESSIONISM (picture).

Sisley was born in Paris of English parents. In the early 1860's, he studied in the Paris studio of the Swiss artist Charles Gleyre. There, he met the future impressionists Jean Frédéric Bazille, Claude Monet, and Pierre Auguste Renoir. Sisley's early pictures emphasized dark browns and greens. By 1870, he was using lighter colors and painting more spontaneously. He did his best work in the 1870's. ALBERT BOIME

SISTERS OF CHARITY are members of several Roman Catholic religious communities of women. They are devoted to serving the poor, the sick, the aged, and the orphaned.

Saint Elizabeth Ann Seton founded the Sisters of Charity in the United States in 1809. She was inspired by the example of Saint Vincent de Paul and the Daughters of Charity, a religious community he founded in France. The American Sisters grew into six separate communities, five in the United States and one in Canada. The U.S. communities are based in Cincinnati, Ohio; Convent Station, N.J.; Emmitsburg, Md.; Greensburg, Pa.; and New York City. The Canadian community is based in Halifax, N.S. The Sisters of Charity also operate in Africa, the Far East, and Latin America. Critically reviewed by the SISTERS OF CHARITY

See also SETON, SAINT ELIZABETH ANN.

SISTERS OF MERCY are members of a Roman Catholic order of nuns. The main mission of the Sisters of Mercy is to care for the poor and sick and to educate the young. The name belongs especially to the congregation of Our Lady of Mercy. This Roman Catholic society was founded in Dublin in 1827. Its founder and first mother superior was Catherine McAuley (Mother Mary Catherine). The first house of the institute in North America was established in Pitts-

burgh, Pa., in 1843. Now there are communities of these Sisters in all parts of the world. Each convent was at first a separate foundation subject to the bishop of the locality. In the United States, there has been since 1929 a more centralized organization with a superior general. Foundations are free to enter this new arrangement if they choose. FULTON J. SHEEN

SISTERS OF THE POOR, LITTLE. See LITTLE SISTERS OF THE POOR.

SISTINE CHAPEL is a famous chapel in the palace of the Vatican in Rome. It was erected by Pope Sixtus IV in 1473. The chief papal ceremonies take place in this chapel. The chapel also is used by the cardinals for the voting by which they elect a new pope. Canonizations and other ceremonies are held in St. Peter's Church.

The Sistine Chapel is a simple building, 134 feet (41 meters) long by 44 feet (13 meters) wide, and 85 feet (26 meters) high. But it has on its walls and ceiling some of the greatest art ever produced in the Western world. Brilliant artists of the early Renaissance decorated the walls with paintings that tell the stories of Moses and Christ. On the ceiling are Biblical stories painted by the great artist, Michelangelo, in the 1500's. It took him four and a half years to complete this ceiling. Its stories tell the history of the creation of the world, the fall of man, and the flood. On the wall above the altar is *The Last Judgment*, a painting 60 feet (18 meters) high and 30 feet (9 meters) broad. Michelangelo began *The Last Judgment* when he was 60 years old and worked on it eight years. Its beauty has been damaged by dust.

The most famous painting in the chapel, *The Creation of Adam*, is in the center of the ceiling. It appears in color in the PAINTING article. CARL K. HERSEY

See also MICHELANGELO (picture); DAVID (picture); JEREMIAH (picture).

SISTINE MADONNA. See MADONNA AND CHILD.

SISYPHUS, *SIS uh fus*, was a king of Corinth in Greek mythology. He was tricky, and his schemes puzzled even the gods.

Once he outwitted Hades, god of the dead. The god Zeus had sent Hades to punish Sisyphus for meddling. Sisyphus tricked Hades and tied him with chains. No man died while Hades was bound. The god Ares freed Hades and gave him power over Sisyphus. Sisyphus secretly told his wife to bury him without the usual funeral rites. After he died and went to the Lower World, he complained to Hades that he had not been buried properly. He begged to return to earth to punish his wife. After Hades let him go, Sisyphus refused to return to the Lower World.

The god Hermes finally captured Sisyphus. As eternal punishment, Hades ordered Sisyphus to roll a huge stone to the top of a high hill. But each time Sisyphus reached the top of the hill with the stone, it rolled back down. G. M. KIRKWOOD

SITAR, *sih TAHR*, is a stringed instrument that originated in India or Persia. It has 6 or 7 main strings, which the musician plucks with his right hand. The sitar also has 12 to 20 *sympathetic strings*, which are not plucked. These strings vibrate when the main strings are played. From 16 to 20 adjustable metal strips, called *frets*, are attached to the neck of the instrument. They serve as fingering guides for the left hand. The sitar has a long, broad neck made of teak and a rounded body made of wood or from a large gourd.

The sitar probably was developed during the A.D. 1200's. It is designed to play classical Indian compositions called *ragas*, which are based on 72 different scales. The frets must be adjusted differently for each of these scales. Sitar music has a sharp, tinny sound that seems harsh to many Westerners. But interest in the instrument has grown in the West since the mid-1960's, when the Beatles and other rock groups began using it. Ravi Shankar of India ranks as the world's best-known sitarist. WINSTON IRVING TAN

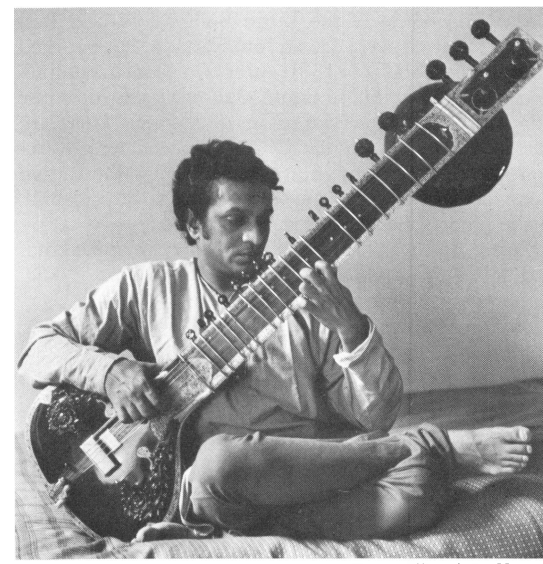
See also MUSIC (picture: Ravi Shankar).

SITKA, Alaska (pop. 3,370), a fishing and lumbering center, is the second oldest city in Alaska. It lies on the west coast of Baranof Island. For location, see ALASKA (political map).

Fishing and lumbering are of equal importance to Sitka's economy. The coastal and inland waters provide quantities of salmon and halibut. The commercially valuable Sitka spruce takes its name from the town. Sitka also has a pulp mill.

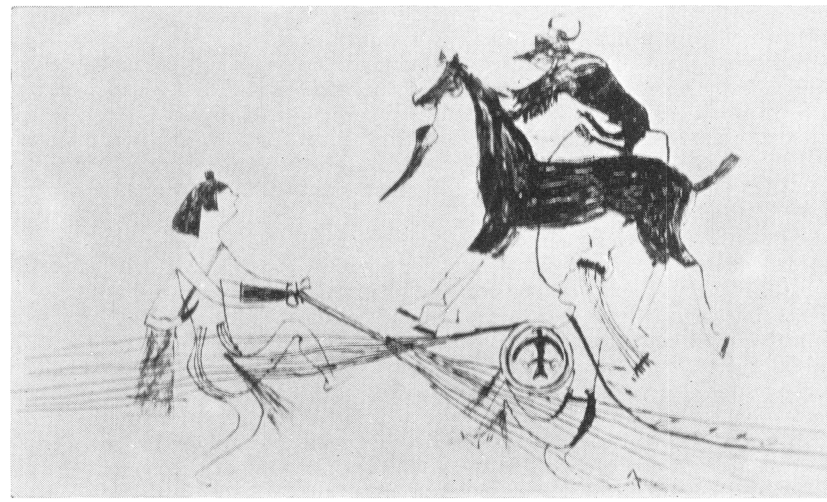
Sitka was founded by Alexander Baranof, a Russian trader, in 1799. It served as headquarters for the fur-gathering enterprises of the Russian-American Company. Originally named *New Archangel*, Sitka became the capital of Russian America in 1807. It was called *The New World Paris*, because it was the Pacific Coast's most important and cosmopolitan city for over a century. When the United States bought Alaska in 1867, the formal transfer took place at Sitka. Sitka was the capital of Alaska from 1884 to 1900.

Sitka's tourist attractions include the Sitka National Historical Park, with its 18 large totems. The city is the site of the Sitka Pioneers Home. The Sheldon Jackson High School and Junior College is the oldest educational institution in Alaska. It offers secondary educa-



Marilyn Silverstone, Magnum

The Sitar is a stringed instrument used primarily to play classical music of India called *ragas*. The Indian musician Ravi Shankar, above, ranks as the world's most famous sitarist. Several rock musicians in Western countries also play the instrument.



Sitting Bull, *above,* **sketched some of his battles with Crow Indians. His drawing,** *right,* **shows him fighting another Indian. The black buffalo seated on the horse is a symbol of his name.**

Brown Bros.; Smithsonian Institution

tion to children of all races. Sitka has a council-manager government. LYMAN E. ALLEN

See also ALASKA (picture: Pulp Mills in Sitka).

SITTING BULL (1834?-1890) was a famous medicine man and leader of the Hunkpapa Sioux Indians. Many people think that he was the leader of the Indians at the battle of the Little Bighorn, on June 25, 1876, in which General George Custer lost his life. Actually, Sitting Bull acted only as the leading medicine man in the preparations for the battle. The year before, he had received a vision that all his enemies would be delivered into his hands. In the spring of 1876, he led a sun dance at which he told the Indians to change their way of fighting. Instead of showing off to prove their bravery, they should fight to kill, or they would lose all their lands to the whites. This new tactic led to the annihilation of Custer and his men.

After the battle of the Little Bighorn, Sitting Bull and his followers were driven into Canada. He returned to the United States in 1881. After two years in confinement at Fort Randall in South Dakota, he lived on the Standing Rock Reservation in that state. There, in 1890, he helped start the Ghost Dance. The government thought this was an attempt to renew the Indian wars, and sent Indian policemen to arrest Sitting Bull. In the process, he and his son were killed.

Sitting Bull was born in what is now South Dakota. As a boy, he was known as *Hunkesni,* meaning *Slow.* But after showing great bravery in a fight against the Crow Indians, he received the name *Sitting Bull.* His father chose the new name. BEATRICE MEDICINE

See also CUSTER, GEORGE A.; SIOUX INDIANS.

SITWELL is the family name of three British writers, two of them brothers and one a sister.

Dame Edith Sitwell (1887-1964) wrote poetry and literary criticism. Her books of poetry include the satirical *Façade* (1922), *Collected Poems* (1930, 1954), and *Music and Ceremonies* (1963). She often gave public readings of her verse. Her critical works include *The Pleasures of Poetry* (1930-1932). From 1916 to 1921, Sitwell edited *Wheels,* an annual poetry anthology. She was born in Scarborough, England, and made her home there.

Rollie McKenna

Edith Sitwell

Sir Osbert Sitwell (1892-1969) recounted the life of English aristocratic and literary groups in the prose works *Left Hand, Right Hand* (1945), *The Scarlet Tree* (1946), *Great Morning* (1948), *Laughter in the Next Room* (1949), and *Noble Essences* (1950). He also wrote short stories. He was born in London.

Sacheverell Sitwell (1897-) wrote many books of art history and poetry. They include *Southern Baroque Art* (1924) and *The Hunters and the Hunted* (1948). He was born in Scarborough, England. JOSEPH E. BAKER

SIVA. See SHIVA.

SIX, LES. See MUSIC (The 1900's); MILHAUD, DARIUS; HONEGGER, ARTHUR; POULENC, FRANCIS.

SIX-DAY WAR. See ISRAEL (History).

SIX NATIONS. See IROQUOIS INDIANS.

SIX PER-CENT METHOD. See INTEREST.

SIX-SHOOTER. See REVOLVER.

SIXTEENTH AMENDMENT. See CONSTITUTION OF THE UNITED STATES (Amendment 16).

SIXTUS was the name of five popes of the Roman Catholic Church. The dates of their reigns were:

Sixtus I, Saint	(115-125)
Sixtus II, Saint	(257-258)
Sixtus III, Saint	(432-440)
Sixtus IV	(1471-1484)
Sixtus V	(1585-1590)

Sixtus IV (1414-1484) became a Franciscan at the age of nine. He later became provincial superior of the order of the Friars Minor, and in 1467 became a cardinal of the Roman Catholic Church. Sixtus was elected pope on the death of Pope Paul II in 1471. His first concern as pope was to overcome the Turks, and he energetically tried to achieve alliances with the Christian nations of Europe for this project. But he failed to accomplish this. Sixtus then tried to consolidate the power of the papal states in Italy, but again failed.

Sixtus' lasting accomplishments included the opening of the Vatican Library and the establishment of the Sistine Choir and the great hospital of Santo Spirito. He also sponsored the development of the Sistine Chapel (see SISTINE CHAPEL). His weakness was his tendency to favor his friends and relatives. Sixtus was born Francesco della Rovere at Celle, Italy.

Sixtus V (1521-1590) entered the order of the Friars Minor at the age of nine. He rose in the order and was made a cardinal in 1570. When Pope Gregory XIII died in 1585, Sixtus was elected pope.

Sixtus was one of the great reforming popes. He strenuously attacked abuses everywhere, and was an able administrator. He fixed the number of cardinals at 70, a number which was not abandoned until 1958. He gave a definite form to papal administration by establishing 15 secretariates, which he called Congregations. He established the Vatican Press, and also urged Philip of Spain to launch the Armada against England. Sixtus was born Felice Peretti in Grottamare, Italy, on Dec. 13, 1521. GUSTAVE WEIGEL and FULTON J. SHEEN

SIZING. See PAPER (Special Kinds); DEXTRIN.

SJAELLAND. See DENMARK (The Land).

SKAGERRAK, *SKAG er ak*, is an arm of the North Sea. The Skagerrak divides Norway and Sweden to the north, and separates them from Denmark on the south. The name is often spelled *Skager-Rak* or *Skagerrack*. The Skagerrak is about 130 miles (209 kilometers) long. It is important because it links the North Sea and the Kattegat. The two channels form the entrance into the Baltic Sea. Along the shores of Jutland, no good harbors for ships exist. This coast is lined with dangerous sand banks. But along Norway, 80 miles (130 kilometers) away, good harbors are plentiful. For location, see EUROPE (map). ROBERT O. REID

SKAGIT RIVER. See WASHINGTON (Rivers).

SKALD, the Icelandic word for *poet*, refers to the Scandinavian poets of the Middle Ages. From the 900's through the 1200's, most court poets in Scandinavia came from Iceland. Most skaldic poetry honored the kings whom the skalds served. Many of these poems, or parts of them, are preserved in the Icelandic *sagas* written in the 1100's and 1200's. Skaldic poetry was complex in form. It employed involved patterns of *alliteration* (repeating the first sound of each word) and *assonance* (similar sounds), and a type of extended metaphor called a *kenning*. KENNETH G. CHAPMAN

See also EDDA; SAGA.

SKATE is the name of a family of *rays*. It is related to the shark. The skate may grow from 1 to 4 feet (30 to 120 centimeters) long and may weigh as much as 100 pounds (45 kilograms). It has two large fins on the sides of its body. These fins are so large that the fish is almost as broad as it is long. The fins have a round edge and form a sort of a disk with the body. The skate has a slender tail which is used as a rudder. It eats snails, mussels, clams, crabs, and other fish. This fish makes its home on the sandy and muddy bottoms along shores, in bays, or in deep water. The skate usually lays egg cases, often called *mermaids' purses*, on these bottoms.

Most kinds of skate are sold as food. One of the best-known species is the *common*, or *summer*, skate, which is found along the Atlantic Coast of North America. This skate is 1 to 2 feet (30 to 61 centimeters) long. A larger skate that lives along the Atlantic Coast is the *barn-door* skate. The *big skate* is a species found along the Pacific Coast.

Scientific Classification. The skate is a member of the skate family, *Rajidae*. The common skate is genus *Raja*, species *R. erinacea;* the barn-door skate is *R. laevis;* and the big skate is *R. binoculata*. LEONARD P. SCHULTZ

See also STING RAY (with picture).

SKATING. See ICE SKATING; ROLLER SKATING.

SKEENA RIVER is one of the most valuable salmon fishing grounds in the world. The river rises in north-central British Columbia and flows southwest to the Pacific Ocean. It is about 335 miles (539 kilometers) long, and drains an area of about 19,300 square miles (49,990 square kilometers). The Skeena empties into Hecate Strait about 10 miles (16 kilometers) south of the city of Prince Rupert. RODERICK HAIG-BROWN

SKEET is an American form of clay target shooting. As in trapshooting, the target is thrown into the air from a metal-sprung trap. Two target houses are located 42 yards (38 meters) apart. The targets spring from each house over the center post between the two houses, and at different angles of flight so as to approximate closely the effect of shooting at winged game.

Seven shooting stations, corresponding to the half face of a clock, are located on a 21-yard (19-meter) radius. Another is in the center of the circle, half way between the two target houses. Shooters, using shotguns, fire from each station. Most targets are thrown as single shots, alternating from each house. But some targets spring out in pairs, one from each target house, at different levels. The shooter tries to bring both down.

The name *skeet* comes from a Scandinavian form of the word *shoot*. CAROLA MANDEL

See also TRAPSHOOTING.

SKELETON is the flexible, bony framework of any vertebrate animal. It gives the body shape, protects vital organs, and provides a system of levers, operated by muscles, that enables the body to move. The skeleton houses *bone marrow*, the blood-forming tissues. It stores elements such as sodium, calcium, and phosphorus, and releases them to the blood. It also holds reserves of protein that the body uses during fasting.

The Human Skeleton

The human skeleton has about 206 separate bones. That is, a human being generally forms that many bones out of cartilage as he develops to maturity. Sixty-four of these bones are in the hands and arms alone.

Bones are joined to neighboring bones by joints. Joints are either immovable, as in the skull, or movable, as in the arms and legs. The bones fit together and are held in place by strong bands of flexible tissue called *ligaments*. The human skeleton is divided into two main parts, the *axial skeleton*, and the *appendicular skeleton*.

The Axial Skeleton is made up of the bones of the head, neck, and trunk. The spine (*spinal column* or *backbone*) forms an axis that supports the other parts of the body. The skull is at the top of the spine. The spine consists of separate bones, called *vertebrae*, with fibrous discs between them. Seven bones make up the *cervical vertebrae* (neck bones). The 12 *thoracic* vertebrae are at the back of the chest.

The ribs are attached to the thoracic vertebrae. Each

A WORLD BOOK SCIENCE PROJECT

COMPARING ANIMAL SKELETONS

The purpose of this science project is to compare the skeletons of four kinds of animals with one another. A comparison of animal skeletons shows that each kind of animal has a special type of bony framework. In this project, the skeletons represent four major groups of animals—amphibians, birds, fish, and mammals. You can study the skeletons of other animals in the same way.

WORLD BOOK illustration by Bill Fleming

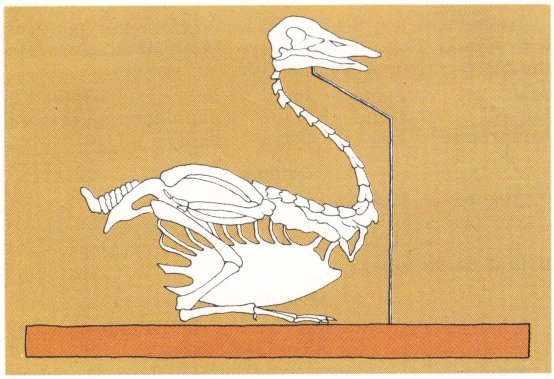
Choose a Work Area that is well-lit and has enough room, so you will not be cramped. Be patient. Your project will come out better if you work slowly and carefully than if you try to rush.

MATERIALS

You can get most of the materials for this project from stores in your community. For example, many local markets sell whole fowl and fish. Biological supply companies sell preserved frogs and rats. Hardware stores carry the rods, stiff wire, and plaster of Paris you will need to mount the bird, fish, and rat skeletons. Most hobby shops have the plastic used in displaying the frog skeleton.

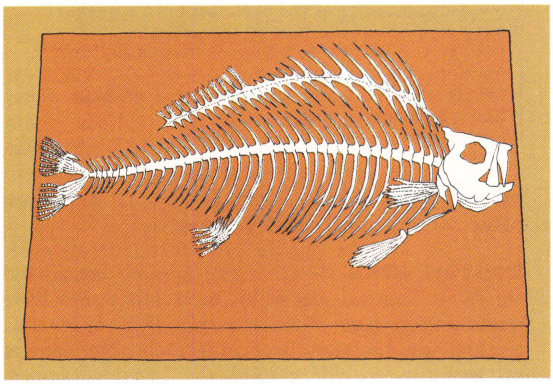
PROCEDURE

To prepare the skeletons for study, remove as much of the flesh as possible from the bones. For all the animals except the fish, soak the bones in hot, soapy water for about two hours. Soak the fish bones for only about 15 minutes. Be sure to keep the water hot, but not boiling. After the bones have soaked for the proper time, scrub them with a stiff brush and rinse them thoroughly. Next, position the skeleton, arranging the bones in their proper place. Then allow the bones to dry completely. Let the bones of the bird skeleton dry before arranging them. Use stiff wire wherever necessary to support the skeletons. Glue all loose bones together with all-purpose glue.



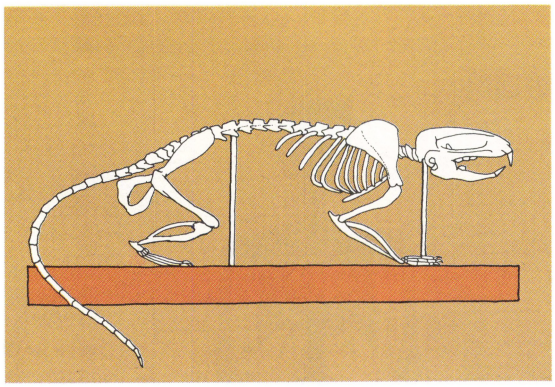
PREPARING A BIRD SKELETON

Bleach the bones of the bird skeleton before you begin to put them together. You can bleach the bones of any of the skeletons used in this project by soaking them in a 10 per cent hydrogen peroxide solution. Let the bones dry thoroughly before assembling them. Use stiff wire to reinforce the bird skeleton and to hold it in the position you want for display. Sink metal rods into a plaster of Paris stand and wire the skeleton securely to the rods.



PREPARING A FISH SKELETON

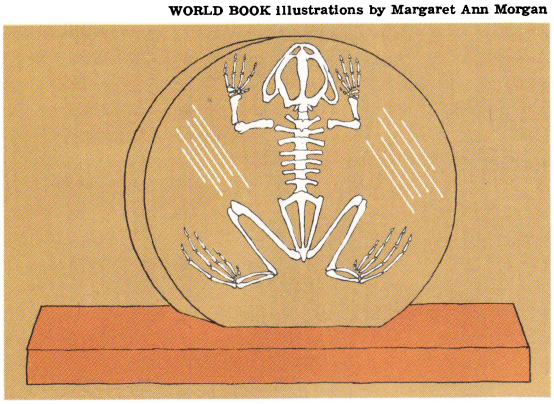
Get a fish at least 12 inches long for this project. Use great care in stripping the tissue from the bones because the skeleton breaks apart easily. Make a cardboard or wood mold about 4 inches longer and 3 inches wider than the skeleton. Pour plaster of Paris into the mold and let it harden. Remove the plaster block and cover it with colored construction paper. Carefully glue the fish skeleton in place in the center of the covered plaster block.



PREPARING A RAT SKELETON

Skin the pelt off the rat and remove as much flesh as possible from the bones. Soak and scrub them carefully so most of the ligaments will stay in place and hold the bones together. Bleach the bones. Place the skeleton in the position you want for display and let the bones dry thoroughly. Glue or wire any loose bones in place. Reinforce the whole skeleton with wire and mount it on a plaster of Paris block covered with construction paper.

WORLD BOOK illustrations by Margaret Ann Morgan



PREPARING A FROG SKELETON

Use a round or square mold of plastic, metal, or heavy cardboard. It should be at least 1 inch larger than the frog skeleton. Place the skeleton in the mold. Pour melted plastic slowly down the side of the mold to prevent bubbling. Let the plastic dry completely, and then remove it from the mold. Smooth the plastic with sandpaper and polish it with a soft cloth. Set the molded skeleton in a plaster of Paris stand covered with colored construction paper.

side usually has 12 ribs. The upper ribs fasten in front to the *sternum* (breastbone). The ribs protect the heart and lungs, and act as a bellows box for the breathing process.

The five *lumbar* vertebrae lie in the lower part of the back. Below the last lumbar vertebra is the *sacrum*. In babies, five separate bones make up the sacrum. In adults, these bones have grown together into one solid structure. The pelvis is attached to the sacral segment of the spine by *sacroiliac joints*. The coccyx is at the bottom of the spine. In children, four separate bones make up the coccyx. But these bones have fused by the time a person is about 25. The point where the sacrum and coccyx meet remains fibrous throughout life.

The Appendicular Skeleton consists of bones of the arms and legs. The *shoulder girdle* consists of the *scapula*, *humerus*, and *clavicle* (collarbone). The skeleton of the arm is divided into the *scapula* (shoulder blade); *humerus* (upper arm); *radius* and *ulna* (forearm); *carpus* (wrist bones); *metacarpus* (hand); and *phalanges* (fingers). The bones of the leg include the *pelvic girdle* (pelvis and sacrum); *femur* (thigh); *tibia* and *fibula* (leg); *tarsus* (back of the foot); *metatarsus* (forefoot); and *phalanges* (toes).

Animal Skeletons

Most backboned animals have two pairs of limbs, front and hind limbs. A giraffe's neck has the same number of bones as a mouse's neck, although the giraffe's bones are longer and larger. Most mammals are *quadrupeds*. That is, they run on all four legs. Man is a *biped* because he walks on only two legs. Many animals without backbones, such as insects and lobsters, have hard body coverings. This *exoskeleton* (external framework) provides both support and protection for the soft parts of their bodies.

MARSHALL R. URIST

Related Articles. See the Trans-Vision color pictures with HUMAN BODY. For pictures of animal skeletons, see the specific articles, such as CAT. See also:

Arm	Foot	Joint	Rib	Spine
Bone	Hand	Leg	Shoulder	Vertebra
Collarbone	Hip	Pelvis	Skull	

Outline

I. The Human Skeleton
A. The Axial Skeleton
B. The Appendicular Skeleton
II. Animal Skeletons

Questions

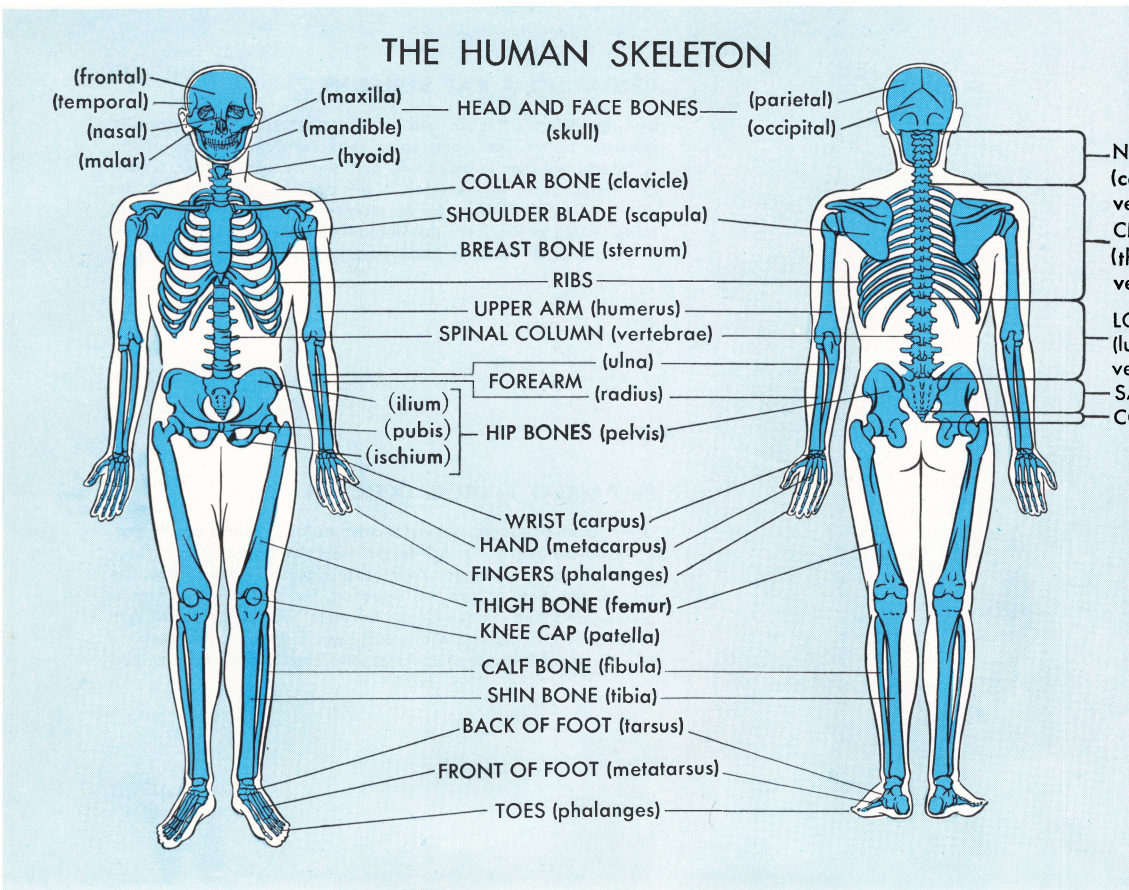
What are the two main parts of the human skeleton? What groups of bones make up each part?
What kind of animals have skeletons?
How many bones are in a human skeleton?
How are the bones of the skeleton held together?
What are some of the jobs of the skeleton?
What are the vertebrae? What is their function?
How does the skeleton develop?
How are the skeletons of backboned animals alike?
What is an exoskeleton?
What are two functions of the ribs?

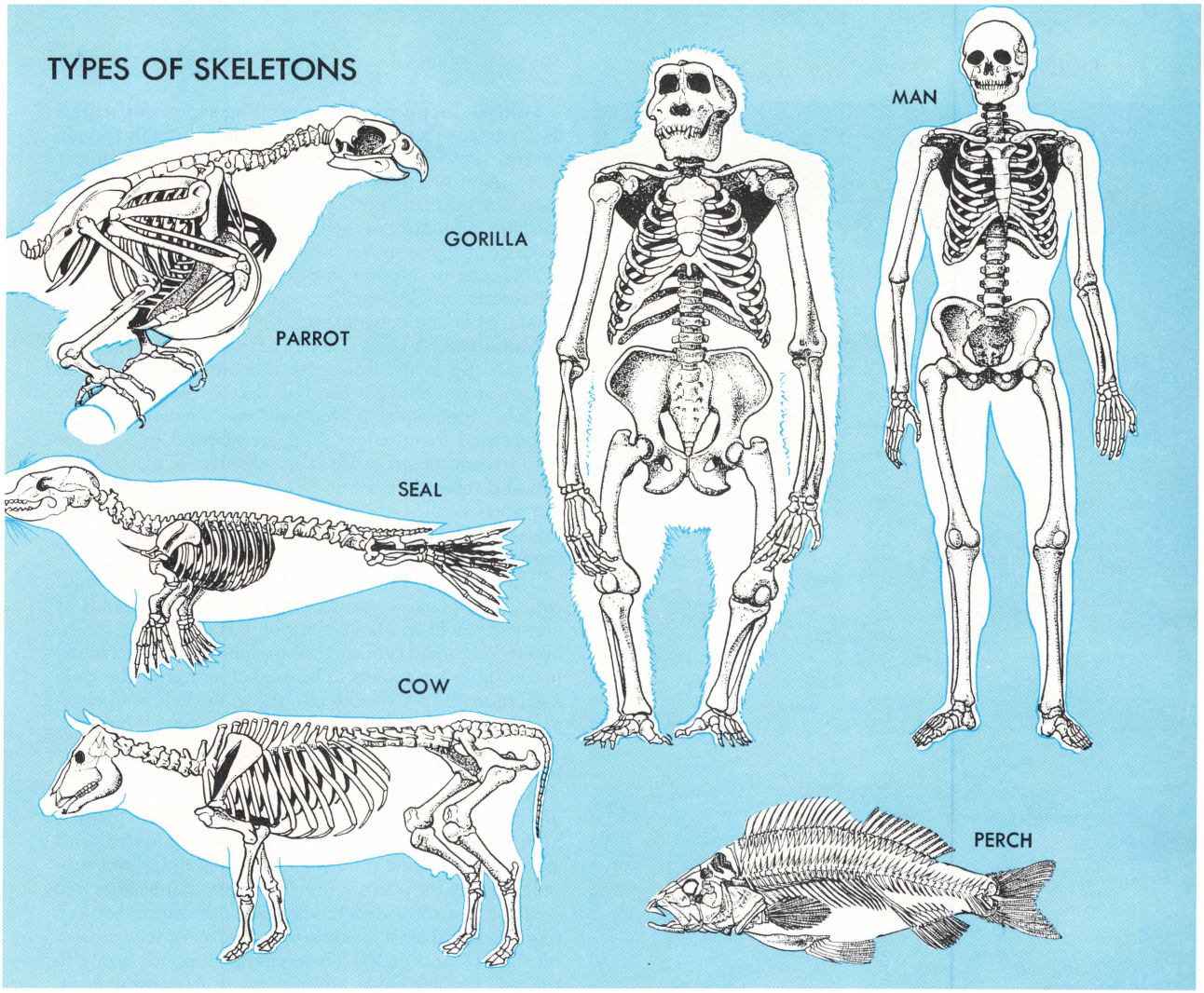
Reading and Study Guide

For a *Reading and Study Guide on the Skeletal System*, see the RESEARCH GUIDE/INDEX, Volume 22.

SKELTON, JOHN (1460?-1529), is often considered the greatest English poet of his time. His satires have earned him the name of the Jonathan Swift of his day.

Skelton was probably born in Norfolk. He lived at court, and tutored Henry VIII, then a young prince. Skelton became a priest in 1498, and served as parson





at Diss in Norfolk. There he wrote *Ware the Hawk*, a savage satire on a priest who preferred hunting with falcons to religion; and *Philip Sparrow*, a playful elegy about a young girl's dead pet bird. About 1520, Skelton wrote three poems that satirize the church and Cardinal Wolsey—*Colin Clout*, *Why Come Ye Not to Court?*, and *Speak, Parrot*. Skelton wrote his poetry in blocks of short, irregular, consecutively rhymed lines, later called *Skeltonic meter*. THOMAS A. ERHARD

SKELTON, MARTHA. See JEFFERSON, THOMAS (Jefferson's Family).

SKEP. See BEE (Beekeeping).

SKEPTICISM was a philosophical movement in ancient Greece. The Skeptics tried to weaken man's confidence in observation and reason as trustworthy guides to understanding the world. They believed that man can be certain of the nature of his observations, but he cannot be sure that these observations reflect the real world. For example, he might think he sees water, but the water may be a mirage. Therefore, man must withhold judgment if he wants happiness and mental peace.

The Skeptics apparently differed over the proper guide to personal conduct. Some believed that a man can best decide how to act by calculating the most practical course of action. Others believed he should follow local laws and customs.

The first Skeptic philosopher was Pyrrho, who lived from about 361 to 270 B.C. The philosophy spread through the Academy, a school in Athens, under the leadership of Arcesilaus during the 200's B.C. and of Carneades in the 100's B.C. No writings of the Skeptics still exist. Summaries of Skeptic doctrines are preserved in Cicero's *Academica* and particularly in the writings of Sextus Empiricus, a Roman physician and Skeptic of the A.D. 200's. JOSIAH B. GOULD

See also CARNEADES.

SKERRIES. See NORWAY (Coast and Islands).

SKETCHING. See DRAWING.

SKEW LINE, in advanced geometry, is a line in space that neither runs parallel to another line nor intersects another line. The word *skew* means *slanting* or *indirect*.

In statistics, a normal distribution has a mound-shaped curve. A curve is said to be *skewed* if it tapers off to the right or left of a mound-shaped distribution curve (see STATISTICS [Frequency Distributions]).

SKEWBACK. See BRIDGE (The Arch Principle).

SKIDMORE COLLEGE. See UNIVERSITIES AND COLLEGES (table).

Margaret Durrance, Photo Researchers

SKIING, *SKEE ing,* is the exciting sport of speeding down a snow-covered slope or soaring through the air on two slats, or runners, called skis. People of almost every country enjoy the thrill of skimming over the snow on skis. In recent years, skiing has gained increasing popularity in the United States. Machines that produce artificial snow have made it possible for people to ski when no natural snow is available. Hundreds of ski resorts provide facilities to make the sport more comfortable and convenient.

Equipment. A *ski* is a long, narrow, flat runner that is turned up at the front end. Skis are made of wood, metal, or sometimes fiberglass that is reinforced with *epoxy* (a strong plastic). Most skis have a plastic running surface and metal edges. Skis are about 3 to 4 inches (8 to 10 centimeters) wide. Most experts use skis that are stiff and more than 1 foot (30 centimeters) longer than the skier is tall. Other skiers use more flexible, shorter skis. Skis 8 feet (2.4 meters) long or longer are used for cross-country racing.

The skier carries two *poles.* These are made of metal, cane, fiber glass, or bamboo and shaped to a point at one end. A little above the point is a circular *basket,* about 3 inches (8 centimeters) in diameter and attached to the pole by spokes. The basket prevents the pole from plunging too deeply into the snow. When a person skis downhill, he uses the poles to help keep his balance. They are also used as walking sticks on flat land and for uphill climbing.

Among the most important safety items for the skier are the *boots.* They are made of stout, pliable leather, and have thick soles that are usually reinforced with steel. The boots fit snugly around the ankles and support them so they do not tire. The boots can be attached to the skis by several methods. One of the safest methods requires metal attachments, called *safety-release bindings,* on the skis and boots. These clamp the boot firmly to the ski, but release it when pressure is exerted in an emergency. This release helps prevent the ski from twisting, spraining, or breaking an ankle.

Where to Ski. Almost any hill that is free from rocks, trees, and other obstructions can be a good place to learn to ski. Special *ski areas* provide many kinds of skiing for persons with all degrees of ability. Such ski areas as Aspen and Vail, Colo., Sun Valley, Ida., Stowe, Vt., Banff, Alta., and Mont Tremblant, Que., attract thousands of skiers. A ski area has one or more *slopes,* the steep sides of hills or mountains. In some areas, the slopes are over 3,000 feet (910 meters) high.

Most ski areas offer the advantage of *lifts.* These mechanically operated devices transport the skier to the top of the slope. The *rope tow* is a rope attached to two pulleys, one at the top of the slope and one at the bottom, and driven by a motor. The skier hangs on to the rope and it pulls him up the slope. The *T-bar* con-

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Bob Beattie, the contributor of this article, is Executive Director of WORLD PRO SKIING.

Skiers Skim Through the Snow at speeds as high as 80 miles (130 kilometers) per hour. They turn and twist to control their speed and to avoid trees and rocks. This slope is at Aspen, Colo.

sists of a motor-driven cable from which metal bars shaped like upside-down letter T's are suspended. The skier leans against the crossbar and holds on to the upright as he goes up the slope. The *chair* lift is a series of chairs hung from a high motor-driven cable. *Gondola* and *cable car* lifts operate in a similar manner, but skiers ride in enclosed cars.

Types of Skiing

Skiing may be divided roughly into two general categories, noncompetitive and competitive. Noncompetitive skiing is recreational. Competitive skiing includes specialized and regulated events.

Noncompetitive Skiing. The most common kind of noncompetitive skiing is the downhill run. When a skier points straight down a slope without trying to turn or slow down, he is said to be *schussing*. A skier *traverses* a slope when he skis at an angle to the *fall line* (a straight line from the skier to the bottom of the slope). He must learn to traverse properly and turn by edging. A skier edges by shifting his weight to the edges of his skis, causing the skis to dig into the snow.

The *snowplow* is usually the first turn a skier learns. It is also used to stop or slow down. To stop or turn, a skier forces out his heels and brings the tips of his skis almost together to form a *V*. At the same time, he shifts his weight to the inside edges of his skis. This helps slow down for his forward motion. A turn occurs when the skier shifts his weight to the ski that is opposite to the direction of the turn.

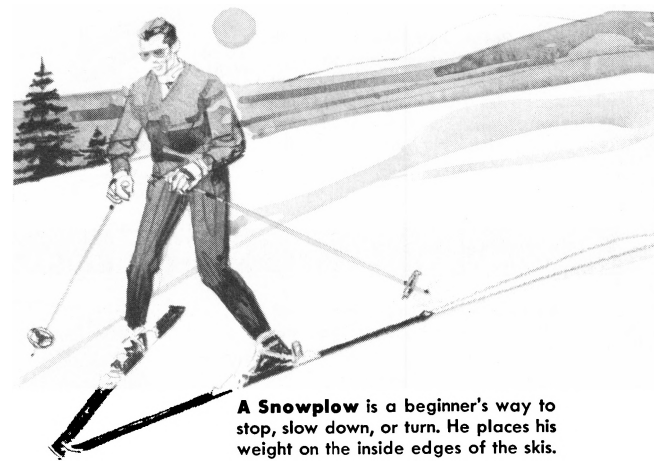
The *stem christie*, sometimes called a *stem turn*, is more difficult than the snowplow. To turn right, a skier *stems* when, by pushing out his left heel, he places his left ski at an angle to the direction of motion. This puts his weight on the left ski and causes it to turn toward the fall line. At the end of the turn, the skis are parallel. The skier reverses the procedure to turn left.

A *parallel christie* is a difficult turn usually done at high speeds. It is sometimes called a *full christiana* or *parallel turn*. To turn right, the skier keeps his skis parallel and shifts his weight to the right edges of his skis by turning his body. To turn left, the skier reverses the procedure. A *wedeln* is a series of short, connected parallel turns.

A skier must also know how to climb the slope. Two common methods are the *herringbone* and *sidestepping*. Both methods require edging at an angle to the slope.

Competitive Skiing. One of the most exciting competitive races is the *downhill*. The object of this event is to start from the top of a 1,500- or 2,500-foot (460- or 762-meter) slope and ski down by the straightest, fastest route possible. *Moguls* (snow mounds), ruts, and other obstacles are added to make many downhill courses more difficult.

The *slalom* is an obstacle course with a vertical drop of 400 to 700 feet (120 to 210 meters). Pairs of closely spaced flag poles mark the edges of a winding, snake-like path. The skier must weave his way between each pair of poles. The *giant slalom* has a drop of 1,000 to 1,300 feet (300 to 396 meters). The sets of flags are farther apart, and the course has steep pitches, moguls, and ruts. Competitors in the downhill and slalom are judged on the basis of speed.

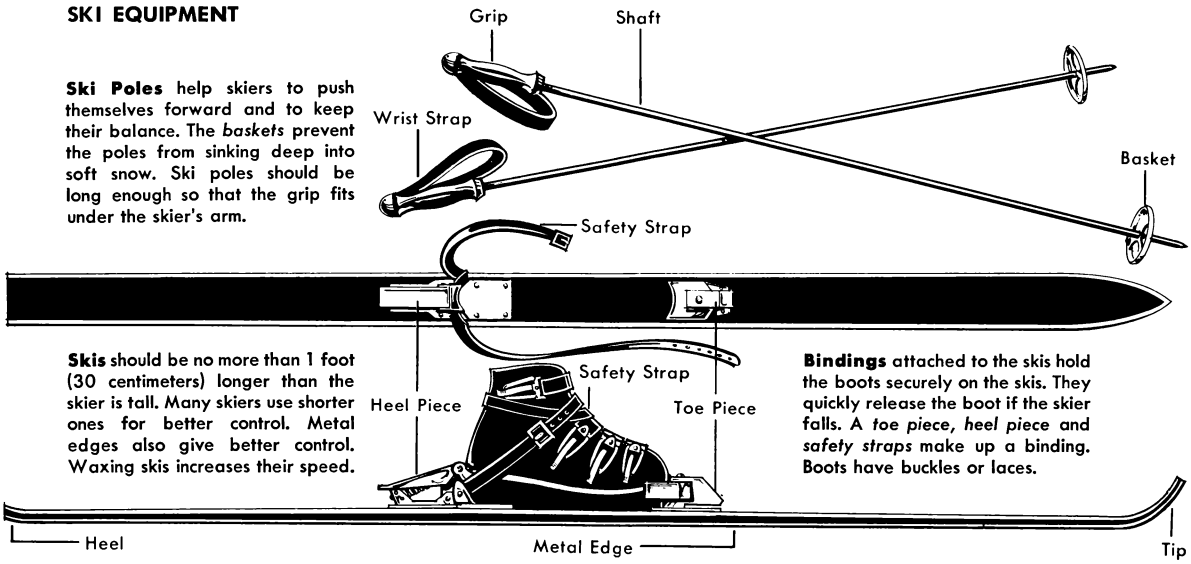


A Snowplow is a beginner's way to stop, slow down, or turn. He places his weight on the inside edges of the skis.

A Stem Christie is a more advanced method of turning. At the end of the turn, the skis are parallel.

WORLD BOOK illustrations by William Gorman

A Parallel Christie requires great coordination. The skier's feet remain close together and parallel throughout the turn. Skiers try to keep their feet together throughout a run.



In *ski-jumping*, the skier speeds down a long, steep take-off that levels off just before ending suddenly, high above the ground. He is judged on the basis of the distance of his jump, and on his control and style in the air and in his landing.

The fourth competitive event is the *cross-country race*. This event tests the stamina, endurance, and all-around technique of the skier. The course consists of natural terrain, and includes uphill, downhill, and flat-land skiing. There are no artificial obstacles, but many trees and rugged trails provide challenges. The Olympic Games include all four of these competitive events.

History

Skiing was developed as a method of transportation by peoples who lived in regions with heavy snowfall. Originally, skis were probably made from the bones of large animals. A pair of skis on exhibit in Stockholm, Sweden, is about 5,000 years old.

Skis later came into use for military purposes. During the battle of Oslo between Norway and Sweden in 1200, the Norwegians used skiers as scouts. Sweden used ski troops in 1521 against Denmark. United States ski troops fought in the Alps during World War II.

Skiing as a sport probably began about the early 1800's. Norwegian immigrants brought it to the United States in the mid-1800's. Fédération Internationale de Ski (FIS) was founded by 26 countries in 1924. This organization convinced the Olympic Games committee to add competition in the winter sports to the program. The first winter games took place in France in 1924.

Outstanding U.S. skiers of the 1940's and 1950's included Arthur Devlin, Alf Engen, Andrea Mead Lawrence, and Torger Tokle. Billy Kidd, Gene Kotlarek, Jean Saubert, and Bud Werner were some of the best-known U.S. skiers of the 1960's and early 1970's. International champions in the late 1960's and early 1970's included Nancy Greene of Canada, Jean-Claude Killy of France, Annemarie Proell and Karl Schranz of Austria, and Gustavo Theoni of Italy. BOB BEATTIE

See also MICHIGAN (Places to Visit); WATER SKIING.

SKIM MILK. See MILK (Other Processes).

SKIMMER, or SCISSORBILL, is a bird related to the gulls and terns. The name *skimmer* comes from its habit of skimming rapidly along the surface of the water. It holds its beak open and keeps the lower part of it beneath the surface, scooping up insects, small fish, shrimp, and other small animals. The name *scissorbill* comes from its thin, bladelike bill, which has the lower part much longer than the upper.

The skimmer holds its body at an angle while flying, to keep its wings from touching the water. There are three species, the one found in America being called the *black skimmer*, or *black scissorbill*. It is black above, and white underneath its body. It makes its nest in a hollow in the sand and lays three to five eggs.

Scientific Classification. Skimmers make up the skimmer family, *Rynchopidae*. The black skimmer is genus *Rynchops*, species *R. nigra*. ALEXANDER WETMORE

See also BIRD (color picture: Water Birds).

SKIN is the largest organ of the human body. If the skin of an adult were spread out flat, it would cover about 18 square feet (1.7 square meters). The skin of an adult weighs about 6 pounds (2.7 kilograms). It is an organ of the body because it performs many essential functions. Perspiration is given off through the skin. The skin also helps the body regulate its own temperature. A piece of skin the size of a quarter contains 1 yard (0.9 meter) of blood vessels, 4 yards (3.7 meters) of nerves, 25 nerve ends, 100 sweat glands, and more than 3 million cells.

There are two basic parts to the skin. The surface is called the *epidermis*, *corneum*, or *cuticle*. This is the part that gets rubbed off when we skin a knuckle. Below this layer lies the *dermis*, or the *corium*. The word *dermis* is taken from the original Greek word for skin. The Greek word *epi*, meaning over, is added to the word *dermis* to form the word *epidermis* for the outer skin.

Epidermis. The top layer of the skin is made up of numerous cells that are placed side by side like the paving stones in a street. There are twelve to fifteen of these rows, arranged one above the other. The cells of

the skin grow from the bottom up. In the lowest row they are shaped like columns, or posts, and are perpendicular to the cells of the under skin. Above this lowest row of epidermis cells are several rows of round cells. These cells grow flatter and flatter toward the surface of the skin. They also become drier as they are pushed upward and outward by the new cells below them. When they finally reach the surface, they are shed as thin flakes. These flakes are the dead skin a person often rubs off with a towel after taking a bath.

Some nerves are located in the lower cells of the epidermis, but there are no blood vessels in the epidermis. Any cut which draws blood must be deep enough to reach the dermis. The epidermis also is responsible for the color of the skin. Dark races have a great deal of pigment called *melanin* in the lower layers of their epidermis. The freckles that appear on the skins of the lighter races also are caused by melanin, and may result from exposure to the sun. The hair and nails are parts of the epidermis that have special functions.

The Dermis is made up of a closely woven network of connective tissue. It is from $\frac{1}{16}$ to $\frac{1}{8}$ inch (1.6 to 3 millimeters) thick. It is thickest on the back and thinnest on the eyelids. In the dermis there are blood vessels, vessels for carrying the lymph, nerves, glands, and hair follicles.

On the outer surface of the dermis are many tiny elevations about $\frac{1}{200}$ inch (0.13 millimeter) high. These are called *papillae*. Their name comes from the Latin word for pimple. The papillae fit into tiny pits on the undersurface of the epidermis and help connect the two layers of the skin. The papillae contain the nerves that are sensitive to touch. They are especially well developed on the inside of the hands, where they are arranged in rows. The fine ridges on the balls of the fingers and thumb show the pattern of the papillae. When a small group of papillae becomes overdeveloped, it sticks out above the epidermis and forms a wart.

Wrinkles in the skin occur when fat and other soft parts beneath the dermis are absorbed into the body and the skin itself does not shrink at the same rate.

The Work of the Skin. There are two kinds of glands in the skin. Some pour out sweat; others discharge oil. The sweat glands are tiny tubes that open up on the surface of the body. There are about two million sweat glands distributed over the surface of the body. They are most abundant on the palms of the hands, the soles of the feet, and the forehead. The sweat glands give off small amounts of liquid waste matter. But their most important function is to regulate body heat. As the sweat evaporates, it cools the surface. The oil glands, or *sebaceous glands*, generally open into the hair follicles. They give off an oily substance that makes the hair smooth and glossy, and keeps the skin from becoming too dry. A blackhead forms when a hard fatty material from an oil gland blocks the gland's opening.

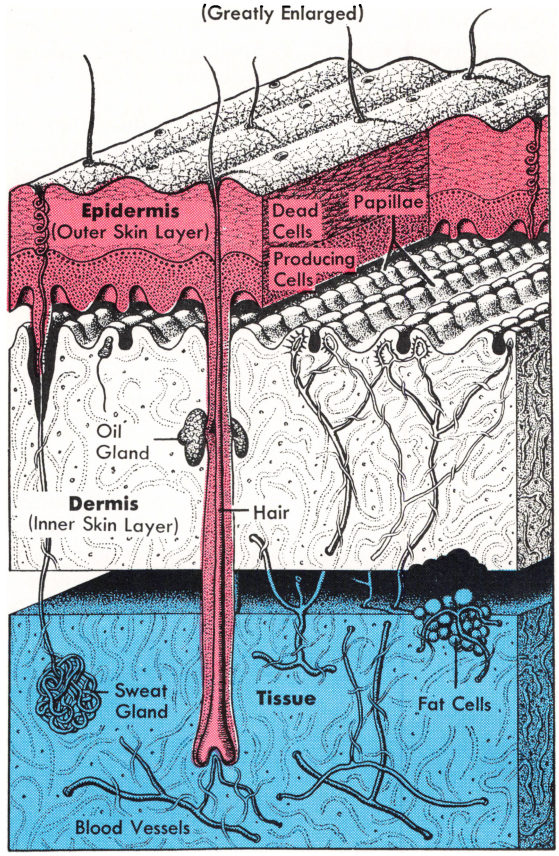
The amount of blood that flows through the skin varies greatly. Blood in the skin helps regulate body heat. If the body needs to give off heat, the blood vessels in the skin expand, and place the blood closer to the outside air. When the body needs to conserve heat, the blood vessels in the skin tend to contract. This slows the rate of heat loss from the body.

Care of the Skin. The most important care that can be given to the skin is to keep it clean. This keeps the tiny pores, or mouths of glands, in the skin from becoming clogged. It also hinders the spread of infection in the skin. Any kind of inflammation or infection in the skin is called *dermatitis*. There are many germs that can infect the skin. The skin also is subject to various rashes that may result from allergies. In some cases, such as in pellagra, the skin may show symptoms of vitamin deficiencies.

W. B. YOUMANS

CROSS SECTION OF HUMAN SKIN

(Greatly Enlarged)



Adapted from *Man in Structure and Function* by Fritz Kahn, by permission of and special arrangement with Alfred A. Knopf, Inc.

Related Articles in WORLD BOOK include:

SKIN DISEASES AND CONDITIONS

Acne	Erysipelas	Pellagra
Athlete's Foot	Erythema	Pimple
Birthmark	Hives	Prickly Heat
Boil	Hyperesthesia	Psoriasis
Callus	Impetigo	Ringworm
Corn	Jungle Rot	Shingles
Dermatitis	Leprosy	Tumor
Eczema	Lupus	Wart
Elephantiasis	Mole	Wen

OTHER RELATED ARTICLES

Beard	Hair	Races of Man
Dermatology	Nail	Scalp
Epithelium	Perspiration	Tissue
Freckles	Pore	

See also *Skin* in the RESEARCH GUIDE/INDEX, Volume 22, for a *Reading and Study Guide*.

SKIN DISEASE. See DERMATOLOGY.

SKIN DIVING is a popular name for *free diving*. Skin divers, or *free divers*, go under water with no air supply, or with metal tanks from which they breathe compressed air.

Skin divers explore the world beneath the surface of rivers, lakes, and oceans. They hunt fish, study nature, and take pictures. Skin divers also search for crime and disaster evidence, repair ships, and do other important work under water.

Skin divers are able to move about under water more freely than *helmet divers*. A helmet diver wears a large helmet that is bolted to a bulky canvas suit. He breathes through a hose that runs from his helmet to pumps or tanks above the water. The air hose and clumsy equipment limits the range and enjoyment of diving. Most of the work that helmet divers once did is now done by skin divers.

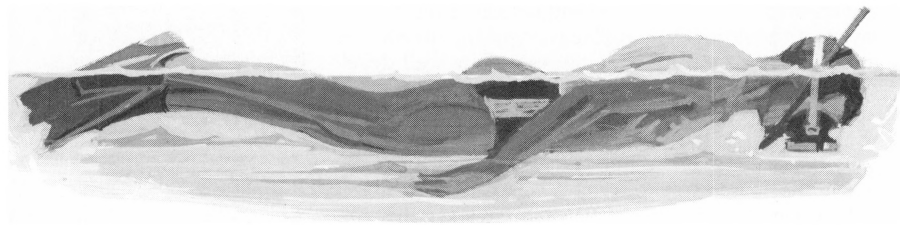
Kinds of Skin Diving

The simplest form of skin diving is to go under water while holding one's breath. This can be done without any equipment. But most skin divers who hold their breath under water swim with rubber foot fins and see through a *face mask*. A face mask consists of a glass plate mounted on rubber. It covers both the eyes and nose. *Mask divers* usually use *snorkels* (short breathing tubes). A snorkel allows a diver to breathe while holding his face down in the water. The best snorkel consists of a tube that is open at the top and is fitted with a mouthpiece at the bottom.

A mask diver with a snorkel swims face down on the surface looking for something of interest under water. Spotting an object, he takes a deep breath and bends sharply from the waist. In this position, he snaps his legs straight into the air and dives head down, toward the bottom.

Divers who hold their breath under water cannot dive very deep or stay under water very long. Therefore, the most common use of this kind of diving is for recreation, such as hunting for fish.

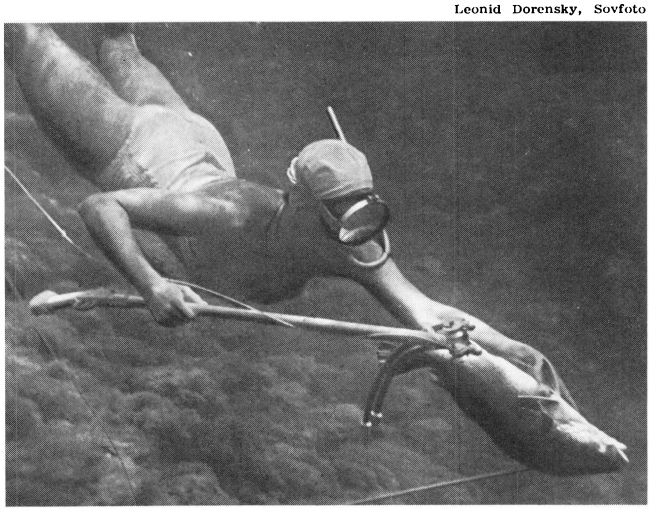
Longer, deeper dives can be made by divers who use independent breathing devices such as the *Aqua-Lung*. An Aqua-Lung diver breathes compressed air through a hose that is attached to metal tanks. The tanks are usually strapped on the diver's back. A valve, called a *demand regulator*, responds to the diver's breathing, and feeds him the exact volume of air that his lungs need to withstand the increased pressure under water. The



Skin Divers usually wear masks so they can see clearly under water. They may swim along the surface, breathing through a short tube called a *snorkel*, while they look for fish or other objects.

Hunters Spearfish in all areas of the world. This underwater hunter has speared a fish in the waters of the Black Sea.

Leonid Dorensky, Sovfoto



Underwater Treasure lures skin divers to sunken ships. The diver, *below*, is recovering a limestone-covered piece of copper.

Peter Throckmorton, Nancy Palmer

Aqua-Lung and similar devices are popularly and incorrectly called *SCUBA* (Self-Contained Underwater Breathing Apparatus).

Many skin divers wear rubber suits to protect their bodies from cold water. The most common type, the *wet suit*, is a tight-fitting coverall of foam rubber or fabric. It is worn over long, woolen underwear that has been soaked with water. The water adds to the suit's ability to retain body heat.

Skin diving instruction by qualified teachers is available at most YMCA and other community center swimming pools. A student diver should be aware of the dangers found under water. Some of these dangers are discussed under DIVING, UNDERWATER (Dangers in Underwater Diving).

History of Skin Diving

Through the ages, divers have used a great variety of equipment to swim under water. Early divers, called *naked divers*, used no equipment to aid their breathing or sight. They dived for pleasure and in search of pearls, sponges, and shells. In A.D. 1300, divers in the Persian Gulf of the Arabian Sea used clear tortoise shell goggles to help them see under water. Divers began using rubber goggles with glass lenses and face masks in the 1930's.

Devices similar to the Aqua-Lung had been designed before 1943, but the Aqua-Lung was the first to use a demand regulator. Developed by Jacques-Yves Cousteau and Émile Gagnan, the Aqua-Lung was first successfully tested by Cousteau in 1943.

The popularity of diving has led to the formation of the Underwater Society of America. The society consists of regional councils representing hundreds of diving clubs. It regulates diving competitions and provides diving information to its members. The Underwater Society of America has headquarters in Ambler, Pa. It is the largest of 40 organizations in the world that belong to the World Underwater Federation, which is headquartered in Paris.

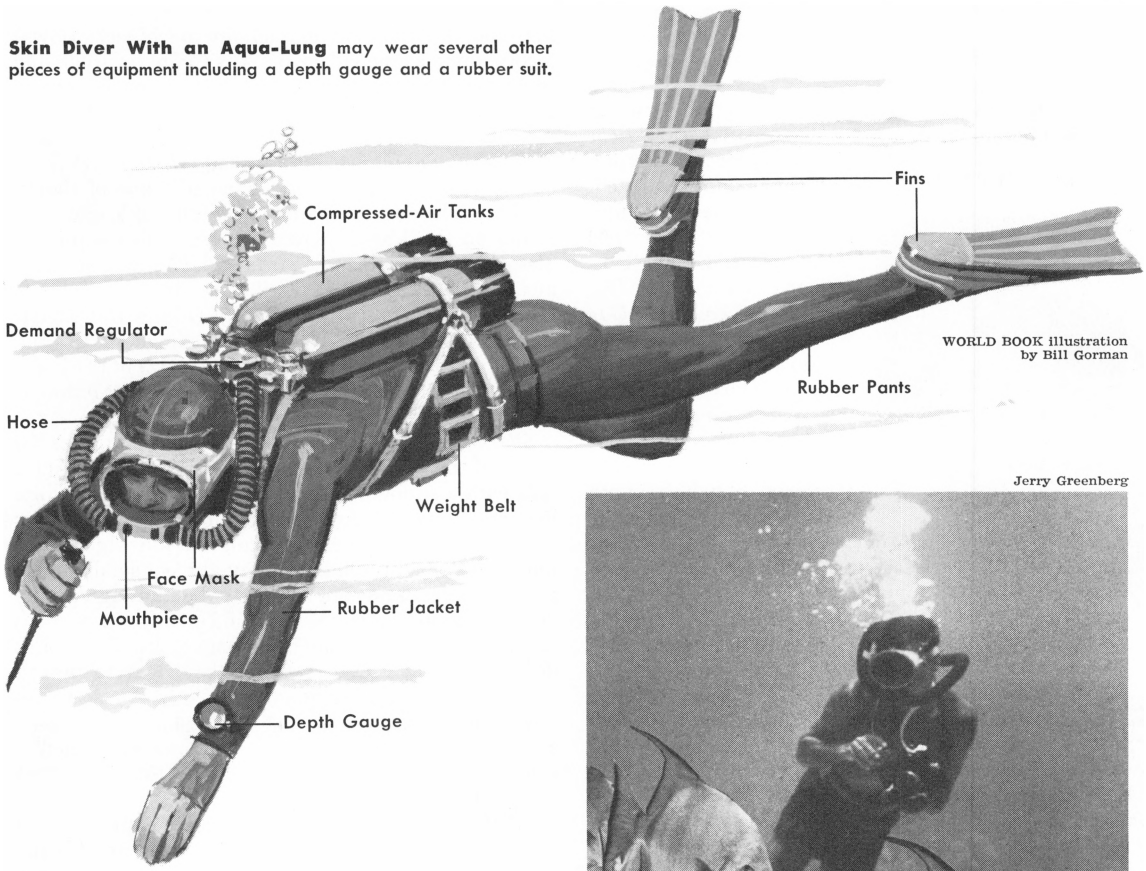
JAMES DUGAN

See also DIVING, UNDERWATER; SPEARFISHING.

SAFE DIVING LIMITS

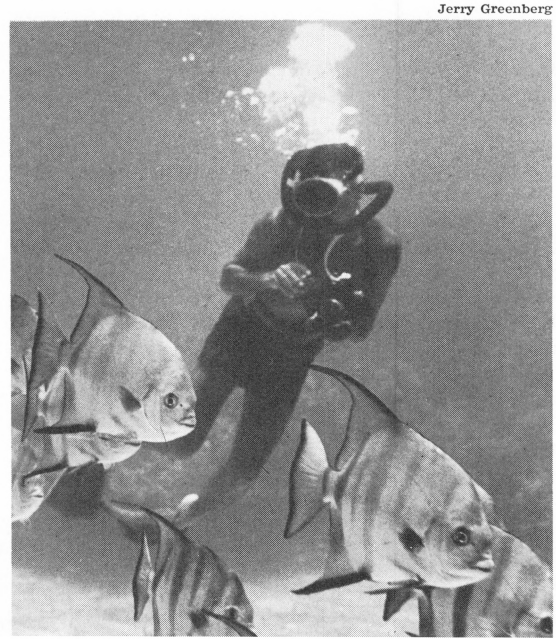
Divers wearing an Aqua-Lung independent breathing device may go safely to the following depths.

100 feet (30 meters)	A trained amateur without experience.
150 feet (46 meters)	A trained amateur with experience.
200 feet (61 meters) and below	A professional diver under full safety controls.



Skin Diver With an Aqua-Lung may wear several other pieces of equipment including a depth gauge and a rubber suit.

WORLD BOOK illustration by Bill Gorman



Jerry Greenberg

An Underwater Cameraman, *right,* can capture many beautiful sights, such as this school of spadefish.

SKIN GRAFTING is the transfer of skin from one part of a body to another. When skin is moved to another part of the same body, the graft is called an *autograft*. When the skin is moved from one body to another, the graft is called a *homograft*. Autografts are more successful and are used more often than homografts.

A thin skin graft is about $\frac{8}{1,000}$ inch (0.2 millimeter) thick and includes all of the *epidermis* (top layer of skin) and a little of the *dermis*. The dermis includes the blood vessels, sweat glands, and *hair follicles* (sacs that hairs grow out of). A full thickness graft includes all of the dermis and epidermis (see SKIN [illustration: Cross Section of Human Skin]). A split thickness graft includes part of the dermis, but does not include the deeper parts of the tubelike sweat glands and hair follicles. Thin and split thickness grafts grow more readily in the new site. Also, the skin grows back more readily at the donor site in thin and split thickness grafts. WILLIAM B. YOUMANS

See also PLASTIC SURGERY.

SKINK. See LIZARD.

SKINNER is the family name of two American actors.

Otis Skinner (1858-1942) was a distinguished actor who skillfully portrayed both comic and sentimental roles. He gained fame as Falstaff, and as Hajj in *Kismet*. His other successes were in the plays *The Duel*, *Mr. Antonio*, *Blood and Sand*, *Cock of the Walk*, and *Sancho Panza*. He was born in Cambridge, Mass. He made his first performance in 1877.

Cornelia Otis Skinner (1901-), the daughter of Otis Skinner, is an actress and writer. She won great popularity for her interpretations in monologues, such as "The Wives of Henry VIII" and "Edna His Wife." With Emily Kimbrough, she wrote *Our Hearts Were Young and Gay* (1942), an account of their trip to Europe as girls.

Cornelia Otis Skinner
Friedman-Abeles

Skinner has played leading roles in *Candida*, *Theatre*, *Lady Windemere's Fan*, and *The Pleasure of His Company*. She also wrote several books, including *Elegant Wits and Grand Horizontals* (1962) and *Madame Sarah* (1967), a biography of actress Sarah Bernhardt. Skinner was born in Chicago. She made her first stage appearance in 1921. MARY VIRGINIA HEINLEIN

SKINNER, B. F. (1904-), is an American psychologist. He is best known for his research into the learning process and his belief in a planned society. Skinner is a leading supporter of *programmed instruction*, in which the principles of learning determined in the laboratory are applied to classroom teaching. He is also known as a student of behavioral psychology, the study of the observable behavior of man. In a popular book, *Walden Two* (1948), Skinner described his idea of an ideal planned society based on principles of learning. In *Beyond Freedom and Dignity* (1971), he called for restriction of individual freedoms that hinder the development of the ideal planned society.

Burrhus Frederic Skinner was born in Susquehanna, Pa. He graduated from Hamilton College in 1926. Skinner soon became interested in the work of the American behavioral psychologist John B. Watson and the Russian physiologist Ivan P. Pavlov. Skinner received a Ph.D. in psychology from Harvard in 1931. He then spent several years studying animal learning and the functions of the central nervous system.

In 1936, Skinner joined the faculty of the University of Minnesota. During World War II (1939-1945), he designed his first "baby box," a controlled environmental chamber for infants. His younger daughter, Deborah, spent part of her first two years in a chamber.

From 1945 to 1948, Skinner served as chairman of the Department of Psychology at Indiana University. He became a member of Harvard's Department of Psychology in 1948. ROBERT G. WEYANT

See also LEARNING (Instrumental Conditioning); TEACHING MACHINE; DEVELOPMENTAL PSYCHOLOGY (Learning Theory).

SKIPPER. See BUTTERFLY (How a Butterfly Flies; Kinds of Butterflies; pictures).

SKJAEGGEDALS, *SHEG uh dahls*, also SKJAEGGEDALSFOSS, is a waterfall in Norway that is 525 feet (160 meters) high.

SKLODOWSKA, MARIE. See CURIE (Marie).

SKOKIE, Ill. (pop. 68,911), is a suburb northwest of Chicago. Its industries include publishing, food processing, and the manufacture of light machinery. It was incorporated as the village of Niles Center in 1888, and took its present name in 1940. It has a mayor-council government. For the location of Skokie, see ILLINOIS (political map). PAUL M. ANGLE

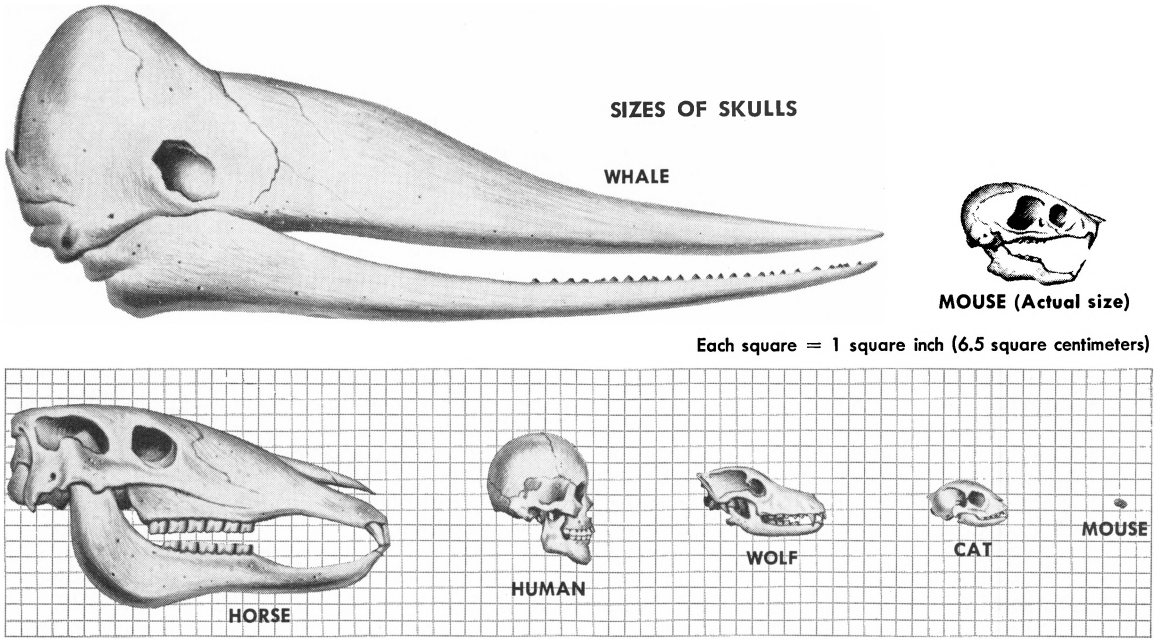
SKOPJE, *SKOH pyeh*, or SKOPLJE, *SKOHP lyeh* (pop. 228,000), is the capital of Macedonia, one of the republics of the Socialist Federal Republic of Yugoslavia. It lies on the Vardar River (see YUGOSLAVIA [map]). Skopje's products include antimony, chrome and other metals, opium, saltpeter, textiles, and tobacco. It is the home of Macedonian University. During the 1200's, the city was the capital of the Serbian kingdom. In July, 1963, an earthquake leveled about 80 per cent of Skopje and killed 1,100 persons. Over half of the city's residents were left homeless. GEORGE KISH

SKUA, *SKYOO uh*, is a bird of prey that lives for much of the year over the ocean. The skua is a fierce bird with a strong, hooked beak and brown-and-white feathers. Skuas are found far out over the sea, where they attack gulls and terns, taking the fish which these birds have caught. On land, they also eat smaller birds and their eggs. They are related to the hunting gulls, or jaegers, but are larger. Skuas build their nests of sticks and grasses on the ground or on bare rocks. These birds do not conceal their nests, but they fight to protect them. See also ANTARCTICA (Birds).

Scientific Classification. The skua belongs to the skua and jaeger family, *Stercorariidae*. The skua is classified as genus *Catharacta*, species *C. skua*. ALEXANDER WETMORE

SKULD. See NORNS.

SKULL is the bony frame of the head of man and other animals with backbones. It is a case made up of bones that enclose and protect the brain, and bones that form the face. The human skull has 22 bones. Eight bones enclose the brain and make up what is called the *cranium*. These eight bones are called the *cranial bones*. The cranial bones are the *occipital*, at the back of the



skull; the *sphenoid*, at the base of the skull; two *parietal* bones, at the top and sides; two *temporal* bones, above the ears; the *frontal*, at the forehead; and the *ethmoid*, at the nose. The other 14 bones of the skull form the face and the jaw. They are called *facial bones*.

Except for the *mandible* (lower jawbone), all the skull bones of an adult form a rigid, united structure. But the skull bones of babies are still growing, and are soft where the bones join. After a few years, the bones grow together in a hard, zigzag joint called a *suture*.

Animal skulls are shaped in ways that help the animal feed according to its way of life. For example, a wolf or cat has long jaws and strong, sharp teeth to grasp and tear its prey. But a horse's broad jaw and flat-edged teeth are shaped for cutting and grinding grasses and plants. The whale has a streamlined skull suited to its life in the water. GORDON FARRELL

See also the Trans-Vision three-dimensional color picture with HUMAN BODY; also HEAD; MANDIBLE; MASTOID; SINUS.

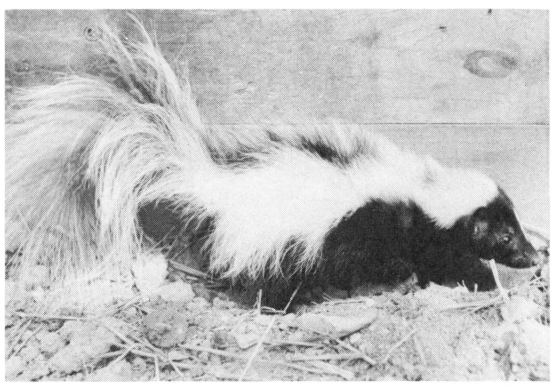
SKULL AND CROSSBONES. See PIRATE.

SKUNK is a small furry animal with distinctive black and white markings. It is known for the foul-smelling liquid it sprays when frightened or in danger. The odor remains for days on whatever has been sprayed.

The sprayed liquid, called *musk*, comes from a pair of glands near the base of the skunk's tail. The animal can spray accurately as far as 12 feet (4 meters). Before it sprays, it gives warning by stamping its front feet and by hissing or growling. There are three chief types of skunks: (1) *striped*, (2) *hog-nosed*, and (3) *spotted*.

The striped skunk has two wide white stripes that form a large V down its back. White fur covers the top of its head, and a thin white stripe runs down the center of its face. Most striped skunks grow from 13 to 18 inches (33 to 46 centimeters) long, not including the tail, and weigh from 3 to 10 pounds (1.4 to 4.5 kilograms). The striped skunk is the most common species in the United States. It also lives in Canada and in northern Mexico.

The hog-nosed skunk resembles the striped skunk. But the hog-nosed skunk has a bare, protruding snout



Carl Koski, NAS

The Striped Skunk sprays an enemy only after giving a warning by growling and stamping its front feet.

Bill Ratcliffe

The Spotted Skunk is the smallest kind of skunk. It may stand on its front feet as a warning before spraying an enemy.

and lacks a face stripe. Some of these skunks have an entirely white back and tail. Most hog-nosed skunks grow from 14 to 19 inches (36 to 48 centimeters) long and weigh from 4 to 10 pounds (1.8 to 4.5 kilograms). Hog-nosed skunks are the only skunks found in South America. They also live in Central America and in the southwestern United States.

The spotted skunk has large white blotches all over its body. A triangular patch of white marks the forehead. Spotted skunks grow from 7 to 14 inches (18 to 36 centimeters) long and weigh from 1 to 3 pounds (0.5 to 1.4 kilograms). They live in the United States and as far south as Central America.

Many skunks live in underground dens that they line with dry leaves. The spotted skunk, unlike the striped and hog-nosed species, can climb, and it sometimes lives in hollow trees. Skunks are active at night and sleep during the day. Those that live in cold climates sleep for weeks at a time in winter, but they do not actually hibernate (see HIBERNATION). Most female skunks give birth to four or five young at a time.

Skunks eat caterpillars and such insects as beetles, crickets, and grasshoppers. They also eat mice, rats, and other small rodents. Sometimes they eat eggs, fruit, grain, and the rotting flesh of squirrels and other animals. Skunks have few enemies, though bobcats and great horned owls sometimes attack them.

Scientific Classification. Skunks belong to the weasel family, *Mustelidae*. The striped skunk is genus *Mephitis*, species *M. mephitis*. Hog-nosed skunks form genus *Conepatus*. A common species is *C. leuconotus*. The spotted skunk is classified as genus *Spilogale*, species *S. putorius*.

JOHN H. KAUFMANN and ARLEEN KAUFMANN

See also ANIMAL (picture: Animals of the Temperate Forests); FUR; POLECAT.

SKUNK CABBAGE is a soft-stemmed plant which is found in low swamps in eastern and central North America. It is known for its heavy, skunklike odor. Skunk cabbage is called a *perennial* because its roots send up new stems each year. The roots are heavy and coarse. The small flowers grow in a thick spike, which is surrounded by a brown leaflike organ called a *spathe*. The spathe gives off an unpleasant odor. The leaves of the skunk cabbage are broad and 1 to 3 feet (30 to 91 centimeters) long. The leaves grow in tufts.

Scientific Classification. The skunk cabbage belongs to the arum family, *Araceae*. It is genus *Symplocarpus*, species *S. foetidus*.

JULIAN A. STEYERMARK

See also LEAF (Leaves That Keep the Plant Warm).

SKY is the name we give to the great dome of the heavens we see above us. To astronomers, the sky is the *celestial sphere*, where celestial objects such as the stars, planets, moon, and sun are fixed. The expression "high in the sky" implies all space from the earth outward. The lower portion of this space is the earth's atmosphere and is the region of wind, rain, and cloud.

The word *sky* is generally thought to have come from the Anglo-Saxon language. In ancient literature the word appears as *skewes*, *skye*, *skiwes*, and *skie*.

The color of the sky results from the air within less than 100 miles (160 kilometers) of the earth. This belt of atmosphere is composed of nitrogen, oxygen, carbon dioxide, water vapor, certain rare gases, and suspended particles. When sunlight passes through the atmosphere, molecules scatter different colors. The shorter the wave length of the light, the more it is scattered. Blue light is scattered the most and red the least. Most of the sky appears blue on a clear day, because these rays are reflected back to us from all parts of the sky. If there were no atmosphere around the earth, part of the sunlight would hit us directly and the rest would go on past. The sky would always look black, with the sun, moon, and stars shining on a great black dome.

If there are only a few dust particles in the air, more blue light is reflected to us. Therefore, the sky appears bluer on a clear day. When the sun rises or sets, the light passes through much more atmosphere than it does when the sun is overhead. Most of the blue light is lost, and we see red or pink colors in the sky and from clouds nearly in front of the sun. The sky is dull in rainy weather because clouds of moisture hide the sunlight.

Poetry and literature often refer to the sky. The expression "praise him to the sky" means to give high praise to a person. The word *firmament* is sometimes used for the sky. An example of this is in Psalms 19: 1, where it is written that "the firmament showeth His handiwork."

R. WILLIAM SHAW

See also ASTRONOMY; HORIZON; LIGHT (Scattering).

SKYDIVING is the sport of parachute-jumping. Skydiving refers to the technique of maintaining absolute control of one's body during a free-fall before the parachute is opened. The skydiver tries to land as near as possible to the center of a target, a 1,000-foot (300-meter) circle. The skydiver leaves the airplane at heights up to 13,000 feet (3,960 meters) in a familiar diver's position. Some skydivers hold their legs apart, and some use the regular swan dive. Certain body movements are used to change direction, maintain balance, and drop on a target. Some divers amuse themselves with turns and spins. The diver opens the parachute at 1,600 to 2,000 feet (490 to 610 meters) above the ground, and then floats to earth at about 12 mph (19 kph). An international meet is held annually. The sport developed in France after World War II.

RICHARD G. HACKENBERG

Ron Church

A Daring Skydiver makes a controlled free-fall before opening the parachute that allows him to float safely to the ground.

THE WORLD'S TALLEST SKYSCRAPERS

Name of Building	City	Stories	Height to Roof		Total Height*	
			In feet	In meters	In feet	In meters
Sears Tower	Chicago	110	1,454	443	1,804	550
World Trade Center	New York City	110	1,350	411	1,350	411
Empire State	New York City	102	1,250	381	1,472	449
Standard Oil	Chicago	80	1,136	346	1,136	346
John Hancock Center	Chicago	100	1,107	337	1,451	442
First Bank Tower†	Toronto	72	935	285	953	290
Chrysler	New York City	77	866	264	1,046	319
Water Tower Place	Chicago	74	859	262	859	262
United California Bank	Los Angeles	62	858	262	858	262
40 Wall Street	New York City	71	851	259	927	283
RCA	New York City	70	850	259	885	270
First National Bank	Chicago	60	844	257	864	263
United States Steel	Pittsburgh	64	841	256	841	256
60 Wall Tower	New York City	66	826	252	950	290
1 Chase Manhattan Plaza	New York City	60	813	248	813	248
Pan Am	New York City	59	808	246	808	246
Woolworth	New York City	60	792	241	792	241
John Hancock Tower	Boston	60	790	241	790	241
Commerce Court West	Toronto	57	784	239	942	287
Bank of America	San Francisco	52	778	237	778	237
IDS Center	Minneapolis	57	775	236	775	236
Exxon	New York City	54	750	229	750	229

*Includes spire, statue, television antenna, or other structure on roof.

†Under construction in 1975.

SKYE TERRIER. This bushy-faced dog is one of the oldest terrier breeds. It originated during the 1600's on the island of Skye, off Scotland, and is kept as a house pet. It is a good rat hunter. The Skye is only 8 to 10 inches (20 to 25 centimeters) high, but its body is about 22 inches (56 centimeters) long. Its ears may be either erect or hanging. Its coat is about 5 inches (13 centimeters) long, and may be dark or light blue, gray, or fawn. The dog has a black muzzle. See also Dog (color picture: Terriers); Terrier.

Josephine Z. Rine

SKYJACKING. See Hijacking.

SKYKJE FALLS, or Skykjedals, is an 820-foot (250-meter) waterfall on the Simoa River in Norway.

SKYLAB. See Space Travel (Space Stations).

SKYLARK. See Lark.

SKYROCKET. See Fireworks.

SKYSCRAPER is the name given to the tallest buildings in big cities. These giant structures were first built in Chicago and New York City, because the high price of land and the limited space made it necessary to build upwards. The development of iron girders capable of supporting many floors made the skyscraper possible.

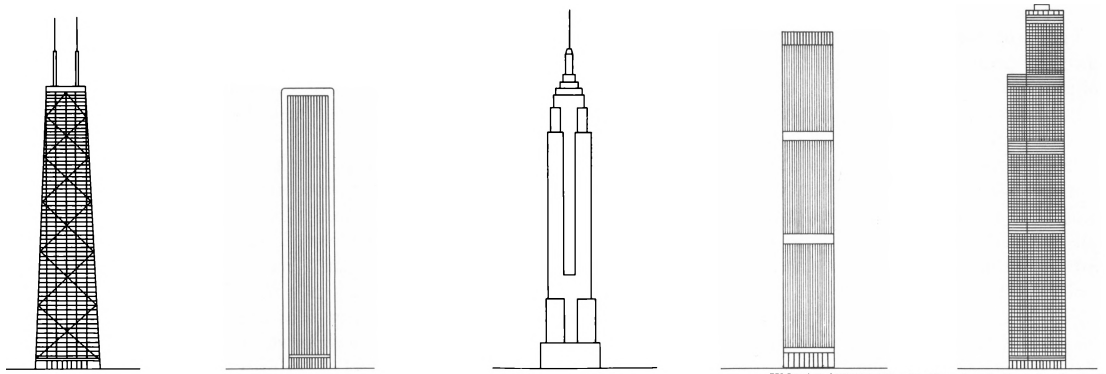
William Le Baron Jenney designed the first skyscraper, the Home Insurance Building, Chicago. It was built with an iron frame in 1884, and torn down in 1931. Skyscrapers are now made of steel and concrete.

Related Articles. See the pictures in the articles for such cities as Chicago; New York City. See also:

Architecture
Building Construction (Constructing a Skyscraper)
Burnham, Daniel H.
Elevator
Empire State Building
Jenney, William Le Baron
Mies van der Rohe, Ludwig
Sullivan, Louis Henri

THE WORLD'S TALLEST SKYSCRAPERS

Skyscrapers line the downtown streets of many of the world's major cities. The five tallest skyscrapers are pictured *below*. The heights given show the distance from the sidewalk to the roof. They do not include antennas or other roof structures.



WORLD BOOK illustration by Arthur L. Grebetz

John Hancock Center
Chicago
1,107 feet
(337 meters)

Standard Oil Building
Chicago
1,136 feet
(346 meters)

Empire State Building
New York City
1,250 feet
(381 meters)

World Trade Center
New York City
1,350 feet
(411 meters)

Sears Tower
Chicago
1,454 feet
(443 meters)

SKYWRITING is a method of writing in the sky with an airplane. A trail of smoke traces the letters. A special preparation mixed with the fuel of the plane produces the smoke. People can see the gigantic letters for many miles. Some advertisers use skywriting to promote their products.

SLAB. See IRON AND STEEL (How Steel Is Shaped).

SLAG is the impure material removed in the process of making pig iron, and in smelting copper, lead, and other metals. The slag from steel blast furnaces is called *cinder*. It contains silicate of calcium, magnesium, and aluminum. The slag from copper and lead-smelting furnaces contains iron silicate, and other metals in small amounts. Slag from open-hearth steel furnaces contains lime and some iron. Often it is smelted again. Slag is sometimes used under pavement in building roads.

SLAM. See BRIDGE (Bidding; Scoring).

SLANDER. A person who tells an untruth likely to injure the reputation or good name of another person may be charged with *slander*. Writing or printing a similar statement is called *libel*. The person responsible for a slanderous statement may be subject to criminal action. The person he has injured may file a civil suit. See also LIBEL.

FRED S. SIEBERT and FRED E. INBAU

SLANG is a kind of language in which words and phrases are used in unconventional ways. It may violate basic rules of good speech, yet effectively convey the thoughts of the speaker. Slang may be vivid, grotesque, expressive, and sometimes vulgar. It has been an important part of everyday speech since men first began to talk to one another.

Slang words and phrases almost always meet with some disapproval when they are first introduced to polite language. Ben Jonson in 1601 attacked the word *strenuous*, then a slang expression, as uncouth and vulgar. Ambrose Bierce, an American journalist, described slang as "the speech of him who robs the literary garbage cans on their way to the dump."

Other people have welcomed slang. The English essayist G. K. Chesterton wrote, "All slang is a metaphor, and all metaphor is poetry." Carl Sandburg called it "language that takes off its coat, spits on its hands, and goes to work." William Shakespeare drew heavily upon the slang of his day for the dialogue of his plays.

Types of Slang. Many, perhaps most, slang expressions are popular for a short time, then die out and are forgotten. *Gib* once meant *pout*, a *cake-eater* was a young man interested in girls. *Do* was once a slang noun meaning fraud, and *mump* a verb meaning to cheat. Other short-lived words were *skiddoo*, *blustiferous*, and *peedoodles*. *Tell it to Sweeney* was briefly a popular slang expression, as were *goo-goo eyes* and *Oh, you kid!* A person using expressions like these today would be considered old-fashioned or, perhaps, would not even be understood.

Another type of slang is that which has enjoyed a long and useful life and appears to be a permanent part of the *slanguage*. Some slang expressions of this sort have been in use for hundreds of years. *Lousy* is such a word. People have spoken it for more than 250 years. Yet *lousy* has never been able to break into polite language. More than 500 years ago, people described a boastful man as one inclined to *blow* and today he may be called a *blowhard*. About 1400, Chaucer referred to a pair of dice as the *bones*. *Booze* was slang even earlier. *Grub* (for food) has been traced back to the 1650's, and *frisk* (for search) to 1781. *Swell* (for excellent) was used in 1888. These words began as slang, have remained slang for many years, and perhaps may never become standard English.

A third type of slang provides standard language with many of its good new words. Some of these words fill an important need and move quickly into polite speech. Others remain on the fringes of polite language for many years and then finally become accepted. *Strenuous* was such a word. It carried Ben Jonson's stigma for centuries. Not until the 1900's did it finally find a secure place in standard English. *Hoax* (for falsehood) was slang in George Washington's day, but was a full member of polite language 50 years later. About 1920, women first arranged their hair in *hairdo's* (a slang term for coiffure). *Hairdo* was standard English in less than 20 years.

Some slang terms express ideas so clearly that one can almost predict their future acceptance as good speech. Such terms include *cold feet*, *wisecrack*, *blurb*, *razz*, *ghost writer*, *hard-boiled*, *double cross*, *stuffed shirt*, *haywire*, *ritzy*, *scab*, *rubberneck*, *easy mark*, *scram*, and *in the doghouse*. Dictionaries disagree today on the status of *skyscraper*, *bootleg*, *bunk*, *gadget*, *vamp*, *jazz*, *hoodlum*, and *highbrow*.

The term *O.K.* (sometimes spelled *okey* or *okay*) has not been accepted as standard English, except when used as a sign of approval on documents. Then it is. The origin of the term, incidentally, is in dispute. Some experts believe it developed from the *O.K. Club*, a group that supported Martin Van Buren for President of the United States in 1840. The club letters stood for Old Kinderhook, N.Y., Van Buren's birthplace. The *O.K. Club* touted Van Buren as "all right." Other authorities believe *O.K.* originally stood for *orl k'rect*, a frontier misspelling of *all correct* that was used by President Andrew Jackson.

Slang is not confined to any one language. French is particularly rich in slang. As in English, much French slang has found its way into the standard language. The word *tête*, for example, is a perfectly good French word meaning head. But it originated as *testa*, meaning pot. Soldiers of the Roman Empire used *testa* as slang for *head*. People in Great Britain and the United States have developed their own slang expressions, which have been freely loaned back and forth across the Atlantic. New Zealanders and Australians have distinctive slang vocabularies.

Sources of Slang. As the dispute over *O.K.* indicates, the sources of slang are often obscure. H. L. Mencken, an American journalist, explained that slang is a "kind of linguistic exuberance, an excess of word-making energy" (see MENCKEN, HENRY L.). Others have pointed out that slang does not necessarily fill any particular need. It may simply be a new way of saying what can be said perfectly well in standard English.

Criminal Cant. The criminal world has long had a slang language almost its own. This slang, called *cant*, developed partly in a deliberate effort to keep outsiders from knowing what the criminals were talking about. It was almost like a code. Thus *bull* came to

mean policeman, and *dip* a thief who robbed the pockets of others. *Skirt* and *broad* (meaning woman) began in this way, as did *moonshine* (for illegal liquor). *Joint* (meaning a place of low repute) is another word that was graduated from cant to slang. Other colorful words that began as cant are *eye* (for detective), *third degree* (for questioning), *gyp* (for cheat), *shakedown* (for search) and *fence* (for receiver of stolen goods).

The *underworld* of large cities produced many slang terms during the gangster period of the 1920's. *Racket* became slang for a dishonest but profitable business. A bomb came to be called a *pineapple* because of the shape of bombs used by gangsters. When a gangster kidnaped a rival gangster and murdered him, it was said the victim was *taken for a ride*. *Moll* (for woman), *heater* and *rod* (for gun), and *needle* (for adding alcohol to liquor) were other slang terms that developed in this period.

Jargon, the vocabulary of special groups, may work its way into the common language as slang. Theater jargon has produced many such words. Among them are *ham* (for bad actor), *turkey* (for failure), *dead-pan* (for a comedian without facial expression), *hoofer* (for dancer), and *the sticks* (for small towns). The amusement journal *Variety* once headed a story "Stix Nix Hix Pix." It meant that motion pictures which made fun of farmers as "hicks" were unpopular in rural areas.

Musicians and their fans have produced much rich slang. Jazz has given the language *hepcat*, *rat race*, *killer-diller*, *jerk*, *blow one's top*, and *jitterbug*. Radio and television produced *stand by* (meaning to wait), *sign off*, *static* (for any disagreeable noise), *disk jockey*, and *Zilch* (for anyone whose name is not known). The publishing world added *deadline*, *handout*, *slug*, and *scoop*.

It is easy to see why the jargon of the theater, radio, and television is likely to spread rapidly to general use. Performers need only to speak their jargon before audiences. People in the audience pick up the expressions and adapt them to their own use.

Farmers, bakers, architects, barbers, bartenders, and carpenters all have words that relate particularly to their work and may be picked up by other people as slang. Aviation has produced many terms, among them *bail out*, *socked-in* (meaning fog-bound), and *flying blind*. Railroads added *highball*, *caboose*, and *sidetrack*.

University students refer to an invitation to a college affair as a *bid*, a sudden thought as a *brain storm*, and a general discussion as a *bull session*. The armed forces during World War II produced *snafu* (situation normal, all fouled up), *blockbuster*, *black market*, *blitz*, *flak*, *Quisling*, *task force*, and *DP* (for displaced person).

Any large organization is likely to produce jargon that may become general slang. One of the big contributors in this way is the United States Department of Defense, whose headquarters are located in the Pentagon in Arlington, Va. This particular slang vocabulary is sometimes called *Pentagonese*, itself a slang word. Pentagonese includes *finalize* (for complete), *flap* (for state of tension or excitement), *bind* (for a prolonged flap), and *File 13* (for wastebasket). In the Navy Department, however, the wastebasket is referred to as *Deep Six*.

Sailors have always been ready inventors of slang. This is perhaps the result of the colorful jargon of the sea, which lends itself to general use. A few examples are *above-board*, *overboard*, *three sheets in the wind*, *Davy Jones' locker*, *pipe down*, *run afoul*, and *keel over*.

Each of the major sports has added to slang. From golf have come *par*, *divot*, and *stymie*. Baseball has produced *home run*, *charley horse*, *bunt*, *fan*, *peg* (a throw), and *seventh-inning stretch*.

Invented Slang. Mencken points out that entertainers and writers produce much of our slang deliberately, as a means of adding freshness to their work. Just as Chaucer may have invented the use of *bones* for dice, Jack Conway, a theatrical writer, produced *palooka* (meaning a person of little ability), *belly laugh*, and *pushover*. Walter Winchell, a newspaper columnist, added *whoopee* to the slang vocabulary. Winchell is also credited with *middle-aisled* and *lohengrined* (for married) and *Reno-vated* (for divorced). T. A. Dorgan, a cartoonist, scored on *dumbbell*, *apple sauce*, and *You said it!* But he missed on *cake-eater* and *Twenty-three*, *skiddoo!*

Fads in Slang change so fast that some expressions no sooner become known than they pass out of style. Someone might be described one year as *out of this world*, but *real gone* the next. Still later, he may be *the greatest*, or even *the most*. Something might be *real hot* during one slang fad and *real cool* during the next. Then it might be *far out*.

Overuse of a slang word robs it of the freshness and novelty upon which slang thrives. There was a period in the 1950's, for example, when *crazy* meant wonderful. Later *crazy* began to mean almost anything. It might even be used as a casual and nonsensical goodby. When this happened, *crazy* quickly passed out of use as a slang expression.

Dangers of Slang. There have been periods in history when any use of slang marked a person as ill-bred or unrefined. It gave him a stigma that handicapped him in polite society. This is not necessarily true today. Educated people often use some slang terms as a relief from formal speech. Slang may add to the zest and fun of conversation. The danger of slang is mainly in its overuse. A slang term becomes tiresome when it is too often repeated. Slang also tends to identify its user with a specific group in society, because various groups tend to use their own styles of slang. A frequent user of slang, therefore, may find himself handicapped when he moves outside his own circle of friends. His speech will mark him as different and, perhaps, of a limited background of experience.

The user of slang also runs the risk of being misunderstood. The meanings of slang terms are not always written down. And they change rapidly. Because of this, a slang term may mean different things to different people.

Experience has shown also that heavy use of slang tends to restrict one's use of standard English. Standard English words have been developed through years of experience to cover almost every shade of meaning. By discriminating use of standard English, a person can convey the most subtle differences of thought. When slang words can contribute to this process, they are usually absorbed into standard English. Then they are no longer slang. DONALD H. LUDGIN

See also DIALECT; IDIOM.

SLAPSTICK COMEDY. See HUMOR; SENNETT, MACK.

SLATE is a type of rock with a sheetlike structure. It consists mainly of tiny grains of minerals. These minerals include chlorite, quartz, and white mica. The grains can be seen only through a microscope. Most slate is colored gray to black, but it may be brown, green, red, or yellow, depending on the mineral content.

Slate is a *metamorphic* rock (see METAMORPHIC ROCK). It is formed in the earth by changes in the form and makeup of shale, a *sedimentary* rock (see SEDIMENTARY ROCK). Sedimentary rocks have layers that look like colored bands. Slate is formed when great weight and pressure within the earth push the mineral grains of shale into sheetlike layers. Slate splits easily along these layers in a process called *slaty cleavage*. The colored bands of slate are the layers of the original shale.

The building construction industry uses large amounts of slate for roofing and flagstones. The principal slate producing states are Maine, New York, Pennsylvania, Vermont, and Virginia. Commercial deposits also occur in the British Isles, chiefly in Wales, and in France and other countries. WILLIAM C. LUTH

See also SHALE.

SLATER, *SLAY ter,* **SAMUEL** (1768-1835), an Englishman, founded the American cotton industry. Born in Belper, Derbyshire, England, Slater was apprenticed at 14 to a former partner of Sir Richard Arkwright, an inventor of cotton-spinning machinery (see ARKWRIGHT, SIR RICHARD). England tried to monopolize the textile industry by forbidding textile machinery, plans, and workers to leave the country. Slater, now skilled in improved textile machinery, left England in 1789 disguised as a farm boy.

He entered the firm of Almy and Brown in Providence, R.I., agreeing to build and operate the cotton-spinning machinery invented by Arkwright. In 1790, the firm opened a 72-spindle mill in Pawtucket, R.I., the first successful spinning mill in the United States (see COTTON [In America]). Slater began manufacturing woolen cloth in 1815. In 1796, he established a Sunday school for the improvement of his workers. This was one of the first institutions of its kind to be established in the United States. KENNETH WIGGINS PORTER

SLATER FUND. See SOUTHERN EDUCATION FOUNDATION.

SLAV, *slahv,* or *slav.* The Slavs, or Slavonians, are a group of people who live in Eastern Europe and Siberia. There are about 200 million Slavs. Most Russians, Poles, Ruthenians, Czechs, Slovaks, Croats, Serbs, Slovenes, Ukrainians, Bulgars, and Montenegrins are Slavs.

The original Slav people were probably a division of the old Aryan-speaking or Indo-European peoples. The early Slavs lived in regions of northwestern Ukraine and southeastern Poland. Most of the early Slavs were farmers and herdsmen. Between A.D. 200 and 500, the Slavs began to migrate to other parts of Europe. They went into regions of Germany, Montenegro, Albania, and Russia.

Slavs form a language group, rather than a race. They vary in appearance according to the region in which they live. Slavs who live near the Mediterranean Sea are much darker than the fair-skinned Slavs of White Russia. Some Slavs are blond, and others have brown hair. Ruthenians have long heads and dark skin, while Poles are roundheaded and light-skinned.

Culture. Slavs have contributed much to the world in education and art. The Charles University in Prague, founded in 1348, was for many years one of the finest schools in Europe. Jagiellonian University in Kraków was the school of the Polish astronomer, Nicolaus Copernicus. Marie Sklodowska Curie, the renowned scientist, was born in Warsaw, Poland. Many outstanding artists and musicians have come from Bohemia. Polish music is world-famous, and Russian music ranks high. Bedřich Smetana and Antonín Dvořák were famous musicians from Bohemia. Polish composers include Frédéric Chopin and Ignace Paderewski. Russia produced such composers as Peter Ilich Tchaikovsky, Nicholas Rimsky-Korsakov, Igor Stravinsky, Sergei Prokofiev, Dimitri Shostakovich, Sergei Rachmaninoff, and Modest Mussorgsky. Russian writers include Fyodor Dostoevsky, Maxim Gorki, and Leo Tolstoy.

History. Every Slav nation has had its national tragedy. The savage tribes of Genghis Khan invaded Russia. Serbia lost its power after the Battle of Kossovo, and the Czechs suffered cruel defeat at the Battle of White Mountain. Polish territory was divided among its enemies three different times. Still the Slavs carried on their struggle for freedom.

About 1830, a Slavic nationalist movement began to arise throughout Europe. The movement was led by Russia and was known as *Panslavism.* The scattered Slavic peoples of Europe began to awaken to the hope of national independence. Panslav congresses were held in Prague, Moscow, and Vienna. Inspired by the thought of unity, the oppressed Slavs grew restless and dissatisfied. They began to demand freedom from foreign control, and discontent reached a boiling point throughout the Balkans. But the movement met with failure because Slav national groups could not cooperate.

After World War I, Poland, Czechoslovakia, and Yugoslavia became independent Slav nations. The Slavs in the Ukraine formed a state in the Soviet Union. Germany destroyed Czechoslovakia in 1939, and divided Poland with Russia. German armies invaded Yugoslavia in 1941. Russian troops drove them out of Poland, Czechoslovakia, and parts of Yugoslavia at the end of World War II. Communist puppet governments imposed their own rule. WILTON MARION KROGMAN

See also CZECH; RUTHENIAN; SLOVAK.

SLAVE LAKE, GREAT. See GREAT SLAVE LAKE.

SLAVE RIVER, or **GREAT SLAVE RIVER,** is an important link in the great Mackenzie River system in Canada. The Slave River is about 258 miles (415 kilometers) long. It flows out of Lake Athabasca in the province of Alberta, and winds in a northerly direction across the Northwest Territories to empty into Great Slave Lake. The Mackenzie River flows out of the western end of Great Slave Lake. Just as the Slave leaves Lake Athabasca, it gets the waters of the Peace River, which also is a part of the Mackenzie system. Midway in its course the smooth flow of the Slave River is interrupted by the 13-mile (21-kilometer) Rapids of the Drowned. Fort Smith, the administrative center of the Mackenzie District, stands at the northern end of the rapids. The transportation value of the Slave River has dwindled with the increase of air, truck, and rail service in the area. W. D. MCDOUGALL

Detail of the Antonina Column in bas relief by an unknown Roman artist. Rome (Alinari from SCALA).

People Captured in Warfare became the chief source of slaves in ancient Rome, *left*, and other early slaveholding societies. Today, slavery still exists in parts of Africa, Asia, and South America.

SLAVERY is a practice in which people own other people. A slave is the property of his owner, called a *master*, and works without pay. The master provides his slaves with food, clothing, and shelter.

Slavery began in prehistoric times and has been practiced ever since. The slavery of ancient times reached its peak in Greece and the Roman Empire. During the Middle Ages, slavery declined. Then, during the 1500's and 1600's, the colonization of the New World by Europeans resulted in a great expansion of slavery. Changing moral attitudes about slavery helped cause its decline during the 1800's. The United States abolished slavery in 1865. Today, slavery is illegal in almost every country of the world. But it still exists in parts of Africa, Asia, and South America.

Development of Slavery

The start of slavery probably followed the development of farming about 10,000 years ago. Farming gave men an opportunity to put their prisoners of war to work for them. People captured in war continued to be the chief source of slaves in the earliest civilizations. Other slaves were criminals or people who could not pay their debts.

Ancient Times. The first known slaves formed the lowest class in the civilization developed by the Sumerians in Mesopotamia (now Iraq) about 3500 B.C. Slavery also existed in Assyria, Babylonia, Egypt, Persia, and other ancient societies of the Middle East. In addition, it was practiced in ancient China and India and among the early Negroes of Africa and the Indians of America. See NEGRO (The Negro in Africa).

Slavery expanded as commerce and industry increased. This growth of trade created a demand for a disciplined labor force that could produce goods for export. As a result, ancient slavery reached its fullest development in the great empires of Greece and Rome. Slaves did most of the work in these societies. Many labored in handicraft industries, in mines, or on plantations. Others worked as household servants, and some even became doctors or poets. During the 400's B.C., slaves may have made up a third of the population of Athens. In Rome, slavery became so widespread that even poor men owned slaves.

Most people of the ancient world regarded slavery as a natural condition of life that could befall anyone at any time. Few writers or other influential people viewed it as evil or unjust.

The treatment of slaves varied greatly, but almost no slaves could legally marry, have a family, testify in court, or own property. In ancient Greece and the Roman Empire, slaves who worked in large gangs in mines or on plantations served long hours and suffered harsh punishment. However, many of those who worked as household servants were treated as well as any member of the master's family.

A slave's chief hope was *manumission* (formal release from slavery by the master). Most ancient slaveholding societies allowed manumission, and many masters guaranteed it in their will as a reward for loyal service.

The Middle Ages. After the Roman Empire broke up in the A.D. 400's, international trade fell sharply. The loss of markets for goods that slaves might have produced led to a decline in the need for slaves. In Europe, slavery slowly changed into serfdom (see SERF).

But slavery continued in the areas around the Mediterranean Sea. Most of it resulted from fighting between two religious groups, Christians and Moslems. During the A.D. 600's and early 700's, Arab Moslems conquered the Middle East, North Africa, and almost all of Spain. Christians and Moslems fought each other in these areas for hundreds of years, and both groups enslaved their prisoners. Some of the fighting occurred during the Crusades—the Christian attempts to recapture Jerusalem and other areas of the Holy Land from

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the Moslems. The Crusades began during the 1000's.

In the Holy Land, the crusaders tasted sugar for the first time. Many of them then created a demand for sugar after returning to Europe. As a result, Italian businessmen established sugar plantations on several Mediterranean islands. The production of sugar required large numbers of laborers, and so the Europeans imported slaves from Russia and other parts of Europe. By 1300, a few African blacks had begun to replace Russian slaves on Italian plantations. These blacks were bought or captured from North African Arabs, who had enslaved them for years.

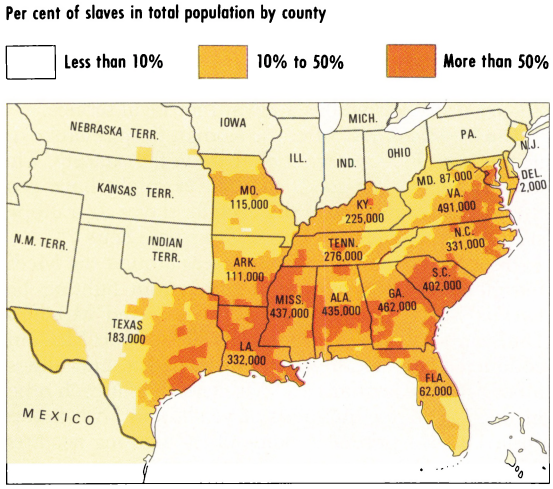
During the 1400's, Portuguese sailors started to explore the coast of West Africa and to ship African blacks to Europe as slaves. The Portuguese also enslaved blacks on sugar plantations that they established on islands off the coast of West Africa.

Throughout the Middle Ages, various peoples in Africa and Asia continued to enslave prisoners of war. During this period, slavery was widely practiced among three groups of Indians. These Indians lived on islands of the Caribbean Sea and also inhabited what are now the northwest coast and eastern woodlands of the United States. Most slaves in the Indian societies worked as farmers or domestic servants. They generally suffered less hardship than the slaves who toiled on European sugar plantations.

Modern Times. The establishment of European colonies in the New World during the 1500's brought expansion of the slave-plantation system. The Spaniards developed sugar plantations in Mexico, and in Cuba and on other Caribbean islands that became known as the West Indies. Portuguese colonists started sugar plantations in Brazil. These Europeans enslaved thousands of Indians. But most of the Indians died from European diseases and harsh treatment. The Europeans then began to import blacks from West Africa as slaves.

SLAVERY IN THE UNITED STATES IN 1860

Most United States slaves served on cotton plantations in the South before the Civil War. The map shows the approximate number of slaves in each state.



WORLD BOOK map

During the 1600's, France, Great Britain, and The Netherlands established colonies in the West Indies and greatly increased the African slave trade. Soon, the Europeans enslaved only blacks. Sugar became the chief export of the European colonies, though the settlers also developed profitable coffee, cotton, and tobacco plantations.

The rising European demand for sugar helped create fierce competition for slaves and for new sugar colonies. From the 1500's to the 1800's, the Europeans shipped about 10 million black slaves from Africa to the Western Hemisphere. About 65 per cent of these slaves were brought to Brazil, Cuba, Jamaica, Saint Domingue (now Haiti), and other sugar colonies. Brazil alone received about 38 per cent of the slaves. North America received only about 6 per cent. See AFRICA (The Slave Trade); NEGRO (The Slave Trade); COLONIAL LIFE IN AMERICA.

Laws in the European colonies of Latin America showed considerable concern for the welfare of slaves. These laws allowed a slave to marry, to seek relief from a cruel master, and even to buy his freedom. Such laws were rarely enforced, however. Partly for this reason, slavery was as cruel in Latin America as it was, later, in the United States. But slaves in the United States generally ate better, lived longer, received better medical care, and had a more secure family life than those in most other countries.

The continual shipment of large numbers of Africans to Latin America gave slaves there certain advantages over Negroes in the United States. For example, African customs could be retained more easily in Latin America.

Slaves in Brazil and the West Indies had less need to adjust to white culture than did blacks in the United States. Blacks greatly outnumbered whites in parts of Brazil and in most West Indies colonies, but the Southern United States had twice as many whites as blacks. The greater number of slaves than whites in those Latin-American areas also made slave revolts more common there than in the United States. The biggest slave revolt in history broke out in Saint Domingue in 1791. Nearly 500,000 slaves rebelled against their French masters and took over the country. See HAITI (Independence).

Slavery in the United States

The enslavement of blacks in the American Colonies began during the 1600's. Slavery flourished in the South, where large plantations grew cotton, tobacco, and other crops. The plantations required large numbers of laborers. But slavery was less profitable in the North, where economic activity centered around small farms and industries.

By 1860, the slave states of the United States had about 4 million slaves. The slaves made up nearly a third of the South's population. For more information on the history of slavery in the United States, see NEGRO (Slavery in America); UNITED STATES, HISTORY OF THE (Expansion; The Irrepressible Conflict).

Views of Slavery. During the 1700's, noted philosophers and religious leaders in Europe and North America began to condemn slavery. They declared that slavery violated human rights and God-given law.

Many Americans turned against slavery during the Revolutionary War in America (1775-1783). These Americans came to believe that slavery had no place in a nation that had been formed to protect the natural rights of men. Few people in the North owned slaves, and opposition to slavery developed more rapidly there than in the South. Some Southerners, including such leaders as George Washington and Thomas Jefferson, spoke out against slavery. But the high profits that resulted from slavery had far greater influence than did any moral arguments.

Support of slavery remained strong throughout the South. But only about a fourth of the region's whites owned slaves or belonged to a family that owned them. About 45,000 planters owned over half the slaves, and these planters controlled the economy and government of the Southern States. Even the many Southerners who did not own slaves accepted the planters' view that the South's economy would collapse without slavery.

During the early 1800's, abolitionists started a crusade to end slavery. Southerners then began to defend slavery in what became known as the *proslavery movement.* Some Southerners in the movement argued that slavery reflected "the law of nature" that permitted the strong to rule the weak. Others insisted that the Bible supported slavery. Still others claimed that Southern slavery provided blacks lifelong security and better living conditions than they would have had in Africa. By 1860, most Southerners identified their honor and destiny with the continuation of slavery.

Functions of Slaves. During the 1600's and 1700's, most slaves in what became the Southern States worked on plantations that grew chiefly indigo, rice, sugar, or tobacco. The invention of the cotton gin in 1793 resulted in fast, large-scale production of cotton. This fiber ranked as the raw material most needed by American and British industry. The high demand for cotton led to the establishment of cotton plantations throughout the South.

During the 1800's, most plantation slaves were *field hands* who planted and picked cotton. *House slaves* worked as servants in the master's home. Other plantation slaves became skilled craftsmen and worked as blacksmiths, bricklayers, cabinetmakers, or carpenters.

Slaves also had a variety of jobs in Southern cities and towns. Many worked in factories. Others became construction workers on canals and railroads or worked as dockworkers, lumberjacks, office workers, or riverboat pilots. Still others toiled in mines.

Conditions of Slavery. Masters housed their slaves and provided them with food and clothing. The amount and quality of these provisions varied widely.

Field hands worked longer than any other kind of slave. Their workday generally lasted from sunrise to sunset. Some field hands were housed as well as free workers. But many others lived under the worst conditions.

Josiah Henson, who later wrote of his experiences as a field hand, recalled that "our dress was of towcloth . . . and a pair of coarse shoes once a year. We lodged in log huts. . . . Wooden floors were an unknown luxury. In a single room were huddled, like cattle, ten or a dozen persons, men, women, and children. . . .

Culver

Slaves Who Picked Cotton on plantations in the United States during the 1800's usually worked from sunrise to sunset.

There were neither bedsteads nor furniture. . . . Our beds were collections of straw and old rags. . . . The wind whistled and the rain and snow blew in through the cracks, and the damp earth soaked in the moisture till the floor was miry as a pig-sty."

Most house slaves lived in their master's home. They worked fewer hours and had more privileges than did field hands, but were more subject to the wishes of the master's family. Most slaves who in time were freed by their owner had worked as house servants.

No Southern State gave slaves the legal right to marry, own property, testify in court, or earn their freedom. Yet some slaves did all these things because slavery, like other human practices, had certain weaknesses. For example, a master had no guarantee of receiving willing obedience or even loyal service from his slaves. To encourage faithful service, some slaveholders treated their slaves kindly and promised them such privileges as gifts and money. Other masters relied on punishment, such as lashings, short rations, and threats to sell members of the slave's family.

Whatever the system of discipline, slavery resulted in a contest of wills between masters and slaves. In this unequal contest, the masters held all the power of reward and punishment. But slaves used flattery, sabotage, and many other tactics to outwit them.

The religion of the slaves played a key role in helping them survive the brutality of slavery. This religion, a mixture of African and Christian beliefs, made the slaves feel part of a community. It also gave them hope of a better life in heaven. State laws prohibited the education of slaves. But the slaves developed their own language, music, and other means of communication.

Many slaves tried to run away to freedom. Thousands succeeded, including those who followed the runaway slave Harriet Tubman along an escape system called the *Underground Railroad.* Some slaves joined organized rebellions, but the whites easily crushed most of these

revolts. Noted leaders of U.S. slave revolts included Gabriel Prosser, Nat Turner, and Denmark Vesey.

Effects of Slavery included a major role in the economic development of the United States. Slaves helped clear the wilderness and build important canals, railroads, and roads. The cotton picked by slaves became the nation's most valuable export. The income from cotton paid for a major share of U.S. imports.

The westward expansion of slavery during the early and mid-1800's had important political effects. Northerners feared that the South would gain control of Congress if Western territories entered the Union as slave states. Attempts by the North to exclude slavery from these territories angered the South and helped bring on the Civil War in 1861.

Slavery had a variety of effects on slaves and masters. It broke the spirit of many blacks but made many others vow to resist it. Slavery caused fear and hate between most masters and slaves. But it created feelings of love and respect between some.

After the Civil War ended in 1865, discrimination and a lack of education prevented most former slaves from obtaining a good job. Discrimination also kept them from receiving the civil rights that they legally had been granted. Historians disagree over how much slavery contributed to discrimination and to other racial conflict that occurred in later years.

The Decline of Slavery

During the late 1700's, black slavery began to decline in various parts of the Western Hemisphere. The Revolutionary War helped cause gradual *emancipation* (freeing of slaves) in the North. In 1808, the United States and Great Britain both outlawed African slave trade.

During the early 1800's, all of Spain's Latin-American colonies except Cuba won wars of independence. These countries immediately abolished slavery or adopted laws for gradual emancipation. Slavery was abolished in the British colonies between 1834 and 1840. In 1848, France freed the slaves in its remaining colonies in the Western Hemisphere.

However, slavery continued to expand in Brazil, Cuba, and the Southern United States. During the Civil War, Northern armies freed most of the slaves in the United States. Adoption of the 13th Amendment to the Constitution completed abolition in 1865. Spain ended slavery in Cuba in 1886, and Brazil abolished slavery in 1888.

Today, few nations legally allow slavery. But slavery does continue in areas of Africa, Asia, and South America. No one knows exactly how many persons still live in slavery. Most of these slaves are blacks and Indians who were captured in local conflicts or were sold to satisfy debts. Slavery remains a strongly accepted custom among the people who practice it. Therefore, some governments may not want to stop slavery, and other governments may be unable to end it even if they wished to do so.

DAVID BRION DAVIS

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Aesop's Fables
Egypt, Ancient
Greece, Ancient (The People; Manufacturing)
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IN AMERICA

See ABOLITIONIST with its list of *Related Articles*. See also:

Allen, Richard
Buchanan, James (The Struggle Over Slavery)
Civil War
Compromise of 1850
Confederate States of America
Constitution of the United States (The Compromises; Amendments 13, 14)
Crittenden Compromise
Dred Scott Decision
Emancipation Proclamation
Folk Music (picture)
Free Soil Party
Freedom Day, National
Fugitive Slave Law
Kansas-Nebraska Act
Liberty Party
Lincoln, Abraham
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Missouri Compromise
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See also *Slavery* in the RESEARCH GUIDE/INDEX, Volume 22, for a *Reading and Study Guide*.

SLAVIC COUNTRIES are nations where most of the people are Slavs (see SLAV). These countries include Czechoslovakia and Poland in central Europe, Bulgaria and Yugoslavia in southern Europe, and Russia, which lies partly in Eastern Europe and partly in Asia.

SLAYTON, DONALD KENT (1924-), a United States astronaut, took part in the Apollo-Soyuz Test Project, the first joint U.S.-Russian space mission. On July 17, 1975, Slayton, Thomas P. Stafford, and Vance D. Brand docked their Apollo spacecraft with a manned Russian spacecraft in orbit around the earth.

Slayton joined the astronaut program in 1959. However, he was removed from active flight status until the early 1970's because of a minor heart ailment. In 1963, Slayton became director of flight crew operations for the National Aeronautics and Space Administration (NASA) at the Lyndon B. Johnson Space Center, near Houston. He was awarded the NASA Distinguished Service Medal in 1965.

Slayton was born in Sparta, Wis. He entered the United States Air Force (then the Army Air Forces) in 1942, and flew 63 combat missions in World War II. Slayton graduated from the University of Minnesota in 1949.

WILLIAM J. CROMIE

See also ASTRONAUT.

SLED is a vehicle that has parallel runners instead of wheels, so that it can move easily over snow or ice. Sleds can be used for sport, but in some parts of the world they are important means of transportation. In the Far North, where snow and ice cover the ground for many months, sleds are the chief means of transportation. People in parts of Alaska and Canada's Yukon Territory travel on sleds pulled by huskies.

Alaskan sleds are built to stand the roughest travel. The most common Alaskan sled is the *Nome sledge*, a long, narrow type with basketlike sides. A good team of dogs, hitched to a Nome sledge, can haul 1,000 pounds (450 kilograms) of cargo. The *Nansen* sled, made of wood and lashed with rawhide, is wider and lighter

than the Nome sledge. However, a 30-pound (14-kilogram) Nansen sled can carry a 600-pound (270-kilogram) load. Sleighs called *troikas* are used in Russia. They are drawn by horses or reindeer. In Lapland, reindeer pull sledges carrying heavy goods.

Early man made crude sledges from logs. He tied these together and dragged them along the ground. Later, men found that the sled would move more easily and quickly if thin slats of wood, called *runners*, were fastened beneath the logs.

The North American Indians used a *toboggan* sled that looked like a canoe on runners. The Pilgrims made sleds of a box set on a pair of runners.

After 1870, the *coasting* sled came into use in the United States. The original coasting sled was the "clipper" type. It was built low, with long, pointed sides and runners of round steel rods. The "girl's sled" was a light, short box, with high, cutout or skeleton sides, and wide, flat runners.

The *double-runner* or *bobsled* was formed of two clipper sleds joined end to end by a board. The rider steered the sled by means of ropes, a wheel, or a crossbar. Four to ten persons rode in the bobsled. Sleds used in bobsled racing are more complex. FRANKLIN M. RECK

See also BOBSLEDDING; DOG SLED; TOBOGGANING; TRANSPORTATION (picture: Land Transportation Without Wheels); TROIKA; SNOWMOBILE.

SLEDGE. See SLED.

SLEEP is a period of rest during which the sleeper loses awareness of his surroundings. Sleep, unlike a coma, is easily ended. A sleeping person or animal can be awakened quickly by, for example, a loud noise or a bright flash of light. All human beings and many kinds of animals must have a certain amount of daily sleep at regular intervals.

What Happens During Sleep. When a person falls asleep, all activity decreases and the muscles relax. His heartbeat and breathing rate slow down. He slowly becomes unaware of what is happening around him.

A sleeping person changes the position of his entire body at least a dozen times during about eight hours of slumber. He moves his head, arms, or legs more often.

Scientists study sleep with an instrument called an *electroencephalograph* (see ELECTROENCEPHALOGRAPH). Whether a person is awake or asleep, his brain gives off electrical waves. An electroencephalograph measures and records these waves. The brain of an awake, relaxed person gives off about 10 small waves a second.

As a person falls deeply into sleep, his brain sends out slower but larger and larger waves. The slowest, largest waves occur during the first two or three hours of a period of sleep. During slow-wave sleep, mental activity slows down but does not stop. Persons awakened from slow-wave sleep can often recall unclear thoughts that they had while asleep.

Periods of small fast waves, similar to those of an awake person, occur at intervals during sleep. During these periods of fast brain wave activity, the sleeper's eyes move rapidly as though they were watching the events of a dream. If a sleeper is awakened during such a period, he probably will recall that he had been dreaming and remember details of the dream. Sleep during these periods is called *dreaming sleep* or *REM* (*R*apid *E*ye *M*ovement) *sleep*. An eight-hour period of sleep includes from three to five intervals of dreaming sleep. These intervals last a total of about 100 minutes. The later dream periods last longer than the earlier ones.

Human Sleep Patterns. Most adults sleep from 7 to $8\frac{1}{2}$ hours every night. Some people, especially those who work at night, sleep during the daytime. Some adults need as little as 6 hours sleep a night—or even less. Others require 9 hours sleep—or even more. Most people need slightly less sleep as they grow older. A man who slept 8 hours a night when he was 30 years old may need only 7 hours of sleep at the age of 60.

A person's sleeping patterns develop gradually. Newborn babies sleep for brief periods throughout the day and night. Their sleep periods include dreaming sleep. By the age of 2 or 3 months, a baby has learned to sleep through the night, though he naps for periods during the daytime. By the age of 6, most children have given up daytime naps. Four-year-olds average from 10 to 14 hours of sleep a day, and 10-year-olds average from 9 to 12 hours.

Sleep Among Animals. Scientists study sleeping animals by the same methods that they study sleeping human beings. Among the *vertebrates* (animals with backbones), only reptiles, birds, and mammals experience true sleep, with changes in brain wave patterns. Most kinds of reptiles do not dream, and most kinds of birds dream only for short periods. All mammals have dream periods and also periods of slow-wave sleep.

Different species of reptiles, birds, and mammals have different sleep patterns. Some sleep for many short periods every day, but others sleep for one long period. Animals that are *nocturnal* (active at night) sleep during the daytime. Some mammals, such as cattle, can sleep standing up. But they dream only while lying down.

The other two groups of vertebrates—fish and amphibians—have periods of what might be called sleep. During these periods, they become less aware than at other times of what is happening around them. But scientists have found no evidence of brain wave changes or dreaming among such animals.

Insects, spiders, and other *invertebrates* (animals without backbones) have daily periods of reduced activity. But invertebrates do not show a sudden decrease in responding to their surroundings. No brain changes have been found to occur during the rest periods of these animals.

What Happens Without Sleep. People who are deprived of sleep lose energy and become quick-tempered. After two days without sleep, a person finds that lengthy concentration becomes difficult. He can force himself to perform tasks well for short periods, but he is easily distracted. He makes many mistakes, especially at routine tasks, and his attention slips at times. Every "sleepless" person experiences periods in which he dozes off for a few seconds or more. He falls completely asleep unless he is kept active continuously.

Persons who go without sleep for more than three days have great difficulty thinking, seeing, and hearing clearly. They have periods of *hallucinations*, during which they see things that do not really exist. They also confuse daydreams with real life and often lose track of their thoughts in the middle of a sentence.

Human beings have gone without sleep for up to 11 days. But men who have stayed awake for so long lose

contact with reality for periods of time. They become suspicious and fearful of others. For example, they may believe that a doctor is really an undertaker who has come to bury them, or that their food has been poisoned.

The Need for Sleep. Sleep restores energy to the body, particularly to the brain and nervous system. People require both slow-wave sleep and dreaming sleep. Extra sleep of either kind does not make up for a lack of the other. Slow-wave sleep may help especially to restore the control of the brain and nervous system over the muscles, glands, and other body systems. Dreaming sleep may be especially important for maintaining such mental activities as learning, reasoning, and emotional adjustment.

Scientists are still seeking answers to many questions about man's need for sleep. They do not know, for example, why man cannot simply rest, as insects do. Nor have they discovered exactly how sleep restores vigor to the body. ERNEST HARTMANN

Related Articles in WORLD BOOK include:

Dream	Insomnia	Sleepwalking
Hibernation	Nightmare	Snoring

SLEEPING BAG. See CAMPING (Sleeping Bags).

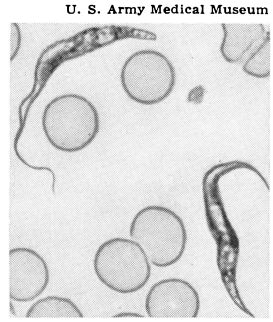
SLEEPING CAR. See PULLMAN, GEORGE MORTIMER.

SLEEPING SICKNESS is the common name for any one of several diseases that result in a deep sleep from which the patient cannot be aroused. But the term usually refers to African sleeping sickness, a disease confined to Africa.

African Sleeping Sickness is technically known as *trypanosomiasis*, because it is caused by a parasite called a *trypanosome* (see TRYPANOSOME). This long, rather thin organism consists of a single cell. A finlike fold, called the *undulating membrane*, grows along the length of the body and ends in a thin, whiplike growth in front. The organism moves by waving or whipping this membrane. When doctors suspect that a person has sleeping sickness, they remove a drop of blood, spinal fluid, or tissue fluid from a swollen gland of the victim. They place this material under a microscope for examination. If the person has the disease, the investigator can see the wiggling parasite.

Sleeping sickness occurs in some places in tropical Africa. The disease parasites may live in certain game animals and domestic livestock as well as in man. A particular kind of fly, called the *tsetse fly*, transmits these parasites from animal to man or from man to man (see TSETSE FLY). The fly becomes infected by sucking the blood of a man or animal that has the disease. The disease organisms enter the insect's body, multiply, and move into the salivary glands and mouth of the fly. When this fly bites a man, it injects some of these parasites into the man's body. The speed with which the disease develops varies.

Sleeping Sickness is caused by long wormlike parasites named *trypanosomes*.
U. S. Army Medical Museum



The kind of sleeping sickness found in East Africa is known as the *Rhodesian* type. It is more severe than the kind found in West Africa.

The first symptoms of sleeping sickness usually are fever, headache, and chills. The patient's lymph glands swell, and a skin rash develops. Soon he becomes quite weak. As the disease progresses, the parasites attack the victim's brain, causing deep sleep and coma (see COMA). Unless he receives treatment, he will usually die. To be effective, treatment must be given before there is severe damage to the patient's nervous system. Once his nervous system has been damaged, complete cure is impossible. Scientists have developed a variety of complex drugs, some of which contain arsenic, to treat sleeping sickness.

Sleeping sickness has caused a serious health problem in Africa. Many African species of trypanosomes produce fatal illness in cattle and horses, making it almost impossible to raise livestock there. As a result, sleeping sickness both of man and of animals has slowed down the development of Africa. Scientists have done much work on measures to control the disease and its carriers. Sometimes they give small doses of drugs to try to prevent the disease. They also try to destroy the breeding and resting places of the tsetse fly.

Encephalitis Lethargica is another disease people often call sleeping sickness. This epidemic disease occurred in many parts of the world during and after World War I (1914-1918). The name *encephalitis lethargica* means *an inflammation of the brain that causes lethargy*, or sleepiness. Some investigators believe that a filterable virus may cause the disease. Researchers during the 1940's and 1950's discovered a large number of insect-transmitted viruses that cause encephalitis in men and animals. The diseases produced by these organisms, however, do not resemble those seen in the early 1920's. Therefore, the cause of encephalitis lethargica is still a scientific mystery. THOMAS H. WELLER

SLEEPLESSNESS. See INSOMNIA.

SLEEPWALKING, or SOMNAMBULISM, is a condition during which a partly awakened sleeper performs various physical activities. Most sleepwalkers simply sit up in bed or stand near their bed. Some actually walk about, but few perform more complicated actions.

Sleepwalking occurs more commonly among children than among adults. A person is most likely to sleepwalk during a period of worry or tension. Sleepwalking rarely occurs while the sleeper is dreaming. After awakening, most sleepwalkers do not recall their activities.

Most sleepwalking is harmless. But a sleepwalker may injure himself by falling out a window or down stairs or by walking into an obstacle. It does not harm a sleepwalker to awaken him. ERNEST HARTMANN

SLEET consists of round, hard balls of ice about the size of raindrops. Sleet usually occurs with showery conditions in unstable air. It is formed in the upper air when droplets of *supercooled* water, water cooled below the 32° F. (0° C) freezing point, come in contact with small ice crystals or snowflakes. The mixture of supercooled water and ice freezes almost instantly. Each little pellet may grow larger if it comes in contact with another supercooled water drop. If a sleet particle falls through a layer of warm air, it may melt and form raindrops.

Sleet pellets rebound when they strike hard surfaces. Sleet and hail are formed in much the same way. But sleet occurs only in winter, because sleet particles are

so small they quickly melt in warm weather. Hailstones, which fall mostly in the spring and summer, may last a fairly long time (see also HAIL). GEORGE F. TAYLOR

SLEIGH. See SLED.

SLICK, SAM. See CANADIAN LITERATURE (The Early 1800's).

SLIDE. See BACTERIOLOGY (Studying Bacteria); MICROTOMY.

SLIDE, in photography. See PHOTOGRAPHY (Color Film); PROJECTOR.

SLIDE RULE is a device used for rapid numerical calculations that involve mainly multiplication and division. It is usually in the form of a ruler. Circular slide rules, with a movable disk attached, are also used. They operate on the same principle. Basically, a slide rule is an addition or subtraction device. For example, arrange two equally divided rulers with the zero of the lower

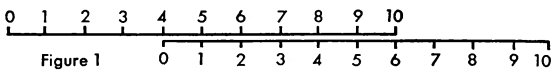


Figure 1

scale below, say, 4 of the upper (as in Figure 1). The numbers on the upper scale are 4 larger than those on the lower. These scales can be used for addition or subtraction simply by sliding the lower scale.

To use rulers for multiplying numbers, logarithmic scales are used (see LOGARITHMS). Mark off the logarithms of numbers and label the marks with the numbers. Figure 2 shows two such scales. Every number on the A scale is twice the number on the B scale immediately below it. If 1 on the B scale had been placed under 3 on the A scale, the multiplier would have been 3. Also in the figure, every number of the A scale divided by the number below it on the B scale gives 2, which illustrates how these scales are used for division. In its perfected

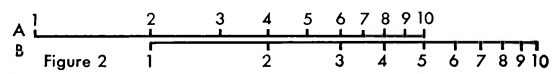
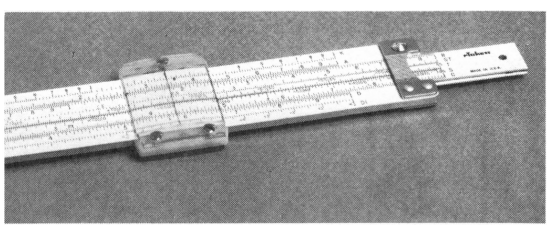


Figure 2

form, a slide rule consists of a ruler with a sliding middle section. Both ruler and the slide have similar logarithmic scales printed on their corresponding edges. A runner or indicator made of transparent material, with a vertical


WORLD BOOK photo

A Slide Rule is a device used chiefly to quickly solve mathematical problems involving multiplication or division.

line down the middle, is used to fix coinciding points on the scales. The slide rule solves problems of multiplying, dividing, squaring, cubing, and extracting square and cube root. Some have additional scales for working out more complicated problems. T. H. HILDEBRANDT

SLIDELL, JOHN. See MASON AND SLIDELL.

SLIME MOLD is a tiny plant of simple structure. It usually grows on decaying wood, and moist soil which contains a large amount of humus. Some slime molds live as parasites on cultivated plants. They cause clubroot of cabbage and powdery scab of potato.

Slime molds have been classed as both animals and plants. In some respects, they resemble tiny animals. The spores are distributed by the wind. Then they germinate and form a simple cell with a single, hairlike attachment called the *flagellum*. With this attachment, the organism swims about. Later, it loses the attachment and several cells unite in a jellylike mass which has the power of slow, creeping movement. This mass, called the *plasmodium*, is sometimes 1 foot (30 centimeters) wide. This forms the vegetable body of slime molds. Finally, the plasmodium develops into masses of moldlike spores which have many forms. The masses are often found on stumps and bark, varying in color from white to orange and red.

Scientific Classification. Slime molds make up the plant phylum *Myxomycophyta*. They are also sometimes classed as the order *Mycetozoa* in the animal phylum *Protozoa*. WILLIAM F. HANNA

SLING is one of the most ancient weapons. It was probably the first weapon designed to hurl a stone with more force than a man could deliver with his hand and arm. In its oldest form, the sling is a leather or hide strap, with a string fastened to each end. A stone or other object is placed on the strap, and the operator holds the two cords in his hand. He whirls the sling above his head, and then lets go of one end of the cord to hurl the stone. Slings are mentioned many times in the Bible. A most familiar reference is to the slaying of Goliath by David with a stone (I Sam. 17:49-50).

The ancient people of the Balearic Islands became famous for their skill with the sling. The sling was of great use to the armies of Egypt, Greece, and Rome. During the Middle Ages, soldiers used slings attached to a staff. They hurled big stones against fortifications.

In America, a small hand catapult is called a *slingshot*, or *sling*. It is made by fastening an elastic band on each prong of a forked stick, and connecting the elastics by a leather pouch. The pouch holds a stone or small metal bullet. The fork is held in one hand, and the elastic is stretched with the other hand. The thumb and first finger hold the stone or bullet in place. The shot is hurled when the elastic is released. Such slings can cause serious injury. Most cities forbid their use.

Bolas are weapons used on the pampas of many South American countries and by the Eskimos. Bolas are made of stone or balls of clay, fastened to the ends of rope or cowhide. The free ends are tied or braided together and used as a handle. The thrower hurls it at a running animal or flying bird. The stones or balls wind the ropes around the animal's legs and throw it to the ground. JACK O'CONNOR

See also INDIAN, AMERICAN (picture: Swinging Their Bolas).

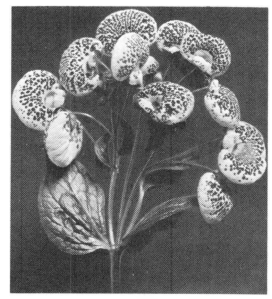
Roman Sling

SLIP. See PORCELAIN

(The Making of Chinaware); POTTERY (Shaping the Clay).

SLIPPED DISK. See BACK.

SLIPPERWORT is the name of several evergreen plants whose blossoms are shaped somewhat like slippers. They are native to tropical America, but several are grown in hothouses and gardens in temperate parts of North America. Slipperworts have many flowers. Popular species include the *common* slipperwort, with spotted yellow flowers, the *bush* slipperwort, which has small yellow flowers, and the *violet-flowered* slipperwort.



J. Horace McFarland

Common Slipperwort

Scientific Classification. Slipperworts belong to the figwort family, *Scrophulariaceae*. The common slipperwort is classified as genus *Calceolaria*, species *C. crenatiflora*. The bush slipperwort is *C. integrifolia*. The violet-flowered slipperwort is *C. purpurea*. PAUL C. STANDLEY

SLIVER. See SPINNING.

SLOAN, JOHN (1871-1951), was an American artist. In 1907, Sloan, Robert Henri, and others formed an informal association of painters called *The Eight* (later the *Ashcan School*). In his paintings, etchings, and illustrations, Sloan honestly and sympathetically portrayed scenes from everyday life. In this way, he came closest to the artistic philosophy of *The Eight*.

Sloan was born in Lock Haven, Pa. He first worked as an illustrator for Philadelphia newspapers. He never traveled abroad, but Henri introduced him to the works of the Europeans Frans Hals, Edouard Manet, and Diego Velázquez. These painters became major influences on Sloan's style. Sloan's favorite subjects include city streets, tenements, cafes, and barrooms. His painting *South Beach Bathers* appears in color in the article UNITED STATES (Art and Architecture). E. MAURICE BLOCH

SLOAN FOUNDATION, ALFRED P., makes grants to universities and other nonprofit organizations. It emphasizes support to education and research in mathematics, engineering, science, economics, management, and cancer. The foundation was established in 1934 by Alfred P. Sloan, Jr., an American industrialist, with an original gift of $500,000. It has offices at 630 Fifth Avenue, New York, N.Y. 10020. For the assets of the foundation, see FOUNDATIONS (table).

Critically reviewed by the ALFRED P. SLOAN FOUNDATION

SLOANE, SIR HANS (1660-1753), was a British physician and botanist. His private collections and library provided the beginning of the British Museum. Throughout his life, he collected plants. The plants he gathered in Jamaica in 1687 and 1688 were the first brought to England from the West Indies. He succeeded Sir Isaac Newton as president of the Royal Society of London. Sloane became a baronet in 1716. He was born in Ireland. LORUS J. MILNE and MARGERY MILNE

SLOBODKIN, *sloh BAHD kin*, **LOUIS** (1903-1975), was an American sculptor and author-illustrator of children's books. He received the Caldecott medal in 1944 for his illustrations for James Thurber's book *Many Moons*. The first children's books he wrote and illustrated were *Friendly Animals* (1944) and *Magic Michael* (1944). His other children's books include *Bixxy and the Secret Message* (1949) and *Amiable Giant* (1955). His sculpture decorates many public buildings. He wrote *Sculpture: Principles and Practice* (1949). Slobodkin was born in Albany, N.Y. RUTH HILL VIGUERS

SLOE, *sloh*, is the name of a spiny, branching shrub related to the plum. It grows in Europe, Central Asia, and the mountains of North America. It has white blossoms which appear before the leaves do. Small black fruits about the size of a pea develop from the flowers. People use these fruits to make wine, jelly, preserves, and dyes. The branches are used to make canes and tool handles. Sloe is sometimes called *blackthorn*.

Scientific Classification. The sloe is in the rose family, *Rosaceae*. It is genus *Prunus*, species *P. spinosa*. J. J. LEVISON

SLOOP. See SAILING (Kinds of Sailboats).

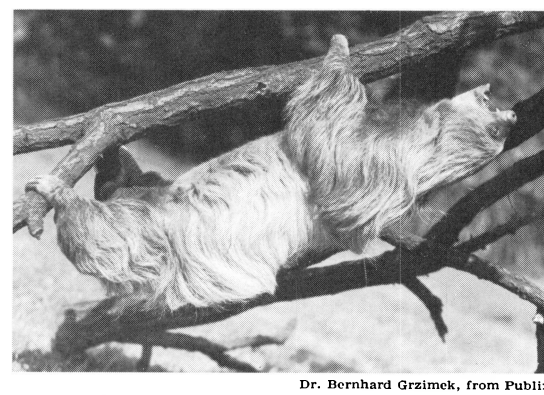
SLOPE MINE. See COAL (Mining Methods).

SLOT CAR RACING. See AUTOMOBILE, MODEL (picture).

SLOT MACHINE is a gambling device that has been outlawed in many states. It is sometimes called the *one-armed bandit*. A player drops a coin into a slot and pulls a lever on the side of the machine. This causes a group of reels to spin. When the reels stop, various combinations show in a small window. The combinations determine if a player wins, or loses his coin. A machine pays a maximum of 20 coins, plus the *jackpot* (all the money showing through another window in the machine). Jackpots are rare, and the slot machine player loses more often than he wins. Charles Fey of San Francisco invented the slot machine in 1895. JOHN SCARNE

SLOTH, *slohth*, or *slawth*, is the common name of a family of South American animals which have a slow and peculiar way of moving about. When moving in the trees, they walk upside down, hanging from branches. Sloths can hang so securely from the branches with their hooklike claws that they even fall asleep in this position. A sloth may even stay suspended in the trees for some time after it dies.

These strange animals have an odd appearance. They have almost no tails or ears, and their noses are blunt. They have peglike teeth. Their hair is long and coarse. In some species, it is grayish in color, which makes



Dr. Bernhard Grzimek, from Publix

Sloths Use Claws to Walk Upside Down on Branches.

them hard to see among the branches. A sloth asleep looks much like the stump of a bough, especially when it has a growth of green algae on the hair, as many sloths do. Sloths seldom come down to the ground. They feed on leaves, buds, and young twigs. They sleep by day and usually move about slowly.

People use the expression "slothful" to describe lazy people. Scientists say that the sloth's sluggishness is, at least partly, caused by its extremely low body temperature. The sloth moves about $\frac{1}{3}$ mile (0.5 kilometer) per hour, when it moves at all. Scientists have discovered that the sloth's speed increases 50 per cent when its body temperature is raised 5 or 6 degrees Fahrenheit (2.8 or 3.3 degrees Celsius).

There are two main species. One, called the *unau*, has two toes on the front feet. The other, called the *ai*, has three toes on the front feet.

Scientific Classification. The sloth makes up the sloth family, *Bradypodidae*. The common two-toed sloth is genus *Choloepus*, species *C. didactylus*. The common three-toed sloth is *Bradypus tridactylus*. FRANK B. GOLLEY

See also ANIMAL (color picture: Animals of the Tropical Forests); GROUND SLOTH.

SLOTH BEAR is a big, shaggy animal with a mane of fur around its neck and shoulders. It is also called a *honey bear* because honey is one of its favorite foods. Sloth bears live in the rocky canyons and hills of India and Sri Lanka. They have a short temper, and can be dangerous when approached.

The sloth bear is about 5 feet (1.5 meters) long and weighs up to 250 pounds (113 kilograms). It has long black fur with a light-colored U-, V-, or Y-shaped patch on the chest. The sloth bear's face is gray and almost hairless.

Sloth bears usually eat *termites* (white ants) and the *larvae* (grubs) of bees. They also eat flowers, leaves, fruits, and grain. They will climb anywhere to get at nests of termites or bees. They use their big feet and long claws to rip open termite nests and to open tree trunks and branches that hold honeycombs. At a termite nest, they blow away the dust and expose the termites. Then they draw the termites into their mouths with loud sucking noises. The sloth bear's lips, tongue, and teeth are well suited to its feeding habits. It has a long snout, flexible lips, and a long sticky tongue.

Sloth bears hunt for food at night. During the day they sleep in protected places, usually in caves along riverbanks. They do not sleep for long periods in the winter as some other bears do.

Most female sloth bears give birth to one or two *cubs* (young bears) at a time. The cubs often ride around on their mother's back.

San Diego Zoo

Sloth Bears have shaggy black fur and a gray, almost hairless face. They live in the hills of India and Sri Lanka.

Scientific Classification. Sloth bears belong to the bear family, *Ursidae*. They make up the genus *Melursus*, and are species *M. ursinus*. CHARLES M. KIRKPATRICK

SLOVAK, *SLO vak*, is the name given about 4 million people living in Czechoslovakia. They are Slavs. The Slovaks look somewhat like the Czechs, but most of them look more like eastern Slavs than like the people of Bohemia. The Slovaks are shorter and smaller-headed than the Czechs.

Early Slovakia, Moravia, and Bohemia made up a mighty kingdom until the death of King Svatopluk in A.D. 894. Then the Slovaks came under the rule of the Magyars of Hungary. The Magyars abused and mistreated the Slovaks, but the Slovaks managed to keep their spirit alive.

In 1867, the new government of Austria-Hungary passed laws to protect all nationalities. But the government did not enforce the laws, and the Slovaks continued to suffer. After World War I, the Slovaks and Czechs formed Czechoslovakia. In 1939, the Nazis destroyed the republic. But, after World War II, the Slovaks and Czechs reunited. WILTON MARION KROGMAN

See also CZECHOSLOVAKIA; SLAV.

SLOVAKIA, *sloh VAH kee uh*, is the eastern part of Czechoslovakia. The region makes up the Slovak Socialist Republic, a political unit of Czechoslovakia. Slovakia is called *Slovensko* in the Slovak language. Bratislava, Czechoslovakia's major port on the Danube River, is the capital and largest city of Slovakia.

Slovakia has an area of 18,922 square miles (49,008 square kilometers). The most fertile area of Slovakia lies in the southwest, between the Danube River and the foothills of the Carpathian Mountains. Slovak farmers raise corn, rye, wheat, fruits, and vegetables. The region has deposits of iron and other ores, *lignite* (a low-quality coal), natural gas, and petroleum. But these deposits do not meet the people's needs, and so Slovakia imports coal and iron ore for its industries. Manufactured products include building materials, chemicals, cloth, iron, leather, paper, and wood.

Slovakia has about 4,542,100 people, or about a third of Czechoslovakia's total population. Most of them belong to a Slavic group called Slovaks. About 554,000 Magyars (Hungarians) and 42,000 Ukrainians also live in Slovakia. Slovakia was once largely agricultural, but it has become more industrialized since the late 1940's. About 40 per cent of the people work in industry, and about 27 per cent work in agriculture. Nearly all the people can read and write. Slovakia's main university is in Bratislava.

By the A.D. 400's, Slavic tribes had settled in what is now Slovakia. During the 800's, the southwestern area of Slovakia became part of the Great Moravian Empire. This empire also included Moravia and parts of Austria, Bohemia, Germany, Poland, and Silesia. The Magyars conquered Slovakia during the early 900's and ruled it for about 1,000 years. At various times between the 900's and the 1500's, noblemen in parts of Slovakia fought for and won some self-governing powers. But the Magyars always regained complete control. The Ottoman Turks conquered Hungary and

southern Slovakia during the mid-1500's and ruled until they were driven out in the late 1600's. However, the Turks had little effect on the lives of most people in Slovakia.

The Slovaks did not begin to develop a separate national identity until the 1800's. During those years, several Slovak leaders worked to develop Slovak national feeling. But the Hungarians opposed these efforts and prohibited expressions of Slovak patriotism.

WORLD BOOK map

Location of Slovakia

In 1867, Austria and Hungary formed a monarchy called Austria-Hungary. Austria-Hungary was one of the losing nations in World War I (1914-1918). In 1918, the Slovaks and the Czechs united and formed the independent republic of Czechoslovakia. Today, the Czech Socialist Republic (consisting of Bohemia and Moravia) and the Slovak Socialist Republic make up Czechoslovakia. VOJTECH MASTNY

See also BRATISLAVA; CZECHOSLOVAKIA.

SLOVENIA, *sloh VEE nee uh,* is one of the six republics that form Yugoslavia. Slovenia covers 7,819 square miles (20,251 square kilometers) on the northwestern border of the country. About 1,740,000 persons, or 8 per cent of Yugoslavia's population, live in Slovenia. Ljubljana, Slovenia's capital and largest city, is the center of cultural life in the region.

Mountains make up much of Slovenia, and thick forests cover about half the land. Mount Triglav, the highest point in Yugoslavia, rises 9,393 feet (2,863 meters) in northwestern Slovenia. Hilly plains spread across the central and eastern parts of the republic. Farmers plant vineyards on many of the hillsides. They raise crops and livestock in fertile valleys.

Tourists visit Slovenia throughout the year. The mountains in the region have ski resorts and beautiful lakes, and Slovenia's coastline on the Adriatic Sea includes good beaches. Tourists also go to the caves at Postojna, near Ljubljana, which are the largest caverns in Europe.

Slovenia has a stronger economy and higher standard of living than any other Yugoslav republic. Manufacturing and trade provide about 60 per cent of Slovenia's income. The leading manufactured products of the republic include automobiles, chemicals, metal goods, and textiles.

WORLD BOOK map

Location of Slovenia

Almost all the people of Slovenia are Slovenes, a Slavic people who speak Slovenian. Most of them also speak Serbo-Croatian, which is used in other parts of Yugoslavia. About two-thirds of the people live in rural areas, and the others live in cities and towns. Most Slovenes belong to the Roman Catholic Church. Slovenia has one university and many other institutions of higher education.

During the late A.D. 500's, Slovenes first settled in what is now Slovenia. German invaders won control of Slovenia by the 800's and ruled until Austrian forces conquered the region in the late 1200's. Slovenia remained under Austrian rule until 1918, except for a period of French control from 1809 to 1815. After World War I ended in 1918, Slovenia became part of a new nation called the Kingdom of the Serbs, Croats, and Slovenes. The name of the country was changed to Yugoslavia in 1929. In 1941, during World War II, Germany and Italy conquered Slovenia and divided it between themselves. After the war ended in 1945, Slovenia was freed and again became part of Yugoslavia. During the 1950's, Slovenia's economy began to grow rapidly. Yugoslavia's first nuclear power plant was scheduled to begin operating at Krsko, near Ljubljana, by 1980. ALVIN Z. RUBINSTEIN

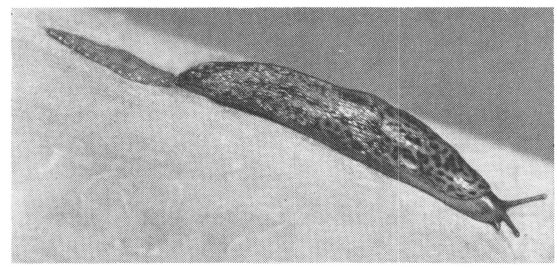
See also LJUBLJANA; YUGOSLAVIA.

SLOWWORM. See BLINDWORM.

SLUG is a kind of snail. Most snails have a shell on the outside of their bodies. Some slugs have a small, flat shell under the skin, but most of them have no shell at all. The slug has two pairs of *tentacles* (feelers) with eyes on the outer end of the longer pair. The great gray slug is a pest because it has a huge appetite for plants. It is about 4 inches (10 centimeters) long.

See also SNAIL.

Scientific Classification. Slugs are in the slug family, *Limacidae*. The great gray slug is genus *Limax*, species *L. maximus*. R. TUCKER ABBOTT



L. W. Brownell

The Slug Leaves a Trail of Slime when it crawls. The slime comes out of the animal's body to lubricate sliding. Slime also protects the slug from sharp objects in its path.

SLUM is a district in which most of the dwellings are dilapidated. Slum dwellings usually lack adequate plumbing, running water, and heating facilities. Buildings often stand crowded together. Occupants of slum areas have low incomes, and several families may live in one dwelling unit. Slums usually are densely populated and have high rates of illness, disease, crime, and delinquency. WILLIAM L. C. WHEATON

See also URBAN RENEWAL; MODEL CITIES.

SLURRY. See CEMENT AND CONCRETE (Crushing).

SMALL BUSINESS ADMINISTRATION (SBA), an independent agency of the United States government, promotes and protects the interests of small business

companies. It offers aid in the form of loans, counseling, and information on management.

The SBA helps victims of disasters and provides special programs to enable members of minority groups to own their own businesses. It also makes sure that small businesses receive a fair share of government purchases and contracts. The SBA issues more than 800 publications in various fields of small business.

The agency has offices in principal cities of every state and in Guam and Puerto Rico. Congress created the SBA in 1953.

Critically reviewed by the SMALL BUSINESS ADMINISTRATION

SMALLPOX is one of the most contagious of known diseases. It attacks persons of all ages. In severe epidemics, 30 of 100 persons attacked may die, while in mild epidemics the death rate may be less than 1 in 100. For hundreds of years, smallpox killed many people every year, and scarred others for life. Today, vaccination has eliminated smallpox in most countries of the world, including the United States.

Smallpox is caused by a small germ, of the group known as *filtrable viruses*. Like many other diseases, smallpox probably is carried by the tiny droplets that are shot out into the air in coughing, sneezing, and even talking. These germ-carrying droplets from an infected person find their way to the mucous lining of the nose and throat of another person. From there, they invade the rest of the body. The germ also is present in skin eruptions. Transmission of smallpox may also take place indirectly through clothing, bedclothes, and utensils.

Smallpox Symptoms. The smallpox *incubation period* (time when germs develop) is usually 7 to 16 days. The first symptoms often are chills, headache, backache, nausea, vomiting, and fever. Red spots appear on the skin about three or four days after the disease begins. These spots become raised, and in a few days change to blisters that fill with pus. They reach their largest size on about the 14th day. The spots usually appear first on the face and arms, then on the trunk and legs. The location of these spots helps physicians tell smallpox from similar diseases. If necessary, laboratory tests may be used for diagnosis. If the patient lives, the blisters dry up, the fever drops, and improvement begins. Scabs are formed which eventually drop off. They leave red or brown discolorations underneath. If the skin eruption was severe, pockmarks may always remain in the skin.

Preventing Smallpox. Edward Jenner, an English physician who developed vaccination in 1796, used cowpox germs as a method of preventing smallpox. People had tried inoculation with smallpox germs before, but until then it was not safe or dependable.

There is no specific cure for smallpox. The only sure way to combat smallpox is vaccination, combined with quarantine of infected persons. When the disease occurs, the sick person should be isolated. All articles of clothing and eating utensils that the person used should be sterilized.

Smallpox may attack a person who has been vaccinated more than five years previous to exposure. A single vaccination usually protects for some years, and limits the severity of infection. For many years, most children in the United States were vaccinated when they were between 1 and 2 years old, and then every 5 years. But in the early 1970's, the U.S. Public Health Service concluded that the risk of complications resulting from such nonselective vaccination of Americans was greater than the probability of their contracting smallpox. It recommended vaccination only for health service personnel and persons traveling to areas where smallpox still exists.

AUSTIN SMITH

See also DISEASE (table); JENNER, EDWARD; VACCINATION; VIRUS.

SMALLS, ROBERT (1839-1915), was a Negro American who became a Union hero during the Civil War (1861-1865). He later had a successful political career.

Smalls was born into slavery in Beaufort, S.C. He became an expert pilot on boats in and around Charleston (S.C.) Harbor. The outbreak of the Civil War gave him the chance to win his freedom. In 1861, the Confederacy forced Smalls to pilot the *Planter*, a messenger and transport steamer. In 1862, Smalls guided the ship out of Charleston Harbor and delivered it to Union officials. After this daring act, he piloted the *Planter* for the Union. Smalls served in the South Carolina legislature from 1868 to 1875, and in the U.S. House of Representatives from 1875 to 1879 and from 1882 to 1887.

RICHARD BARDOLPH

SMALT. See COBALT (Uses).

SMARTWEED is an annual plant that grows as a weed in North America. Its flowers are pink or greenish and it may grow 5 feet (1.5 meters) high. It grows in low places and sometimes in water. The *lady's-thumb* is one of the most common smartweeds.

Scientific Classification. Smartweeds belong to the buckwheat family, *Polygonaceae*. They make up the genus *Polygonum*. Lady's-thumb is *P. persicaria*.

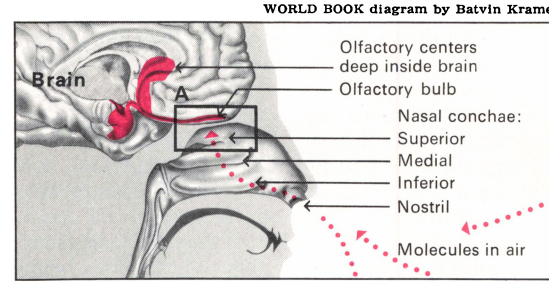
EARL L. CORE

SMELL is one of the most important and basic senses in animals and man. Some animals use the sense of

OUR SENSE OF SMELL

Odors are smelled when molecules of a substance travel through the nasal passages and touch the olfactory nerves. These nerves carry messages about odors to the brain.

WORLD BOOK diagram by Batvin Kramer



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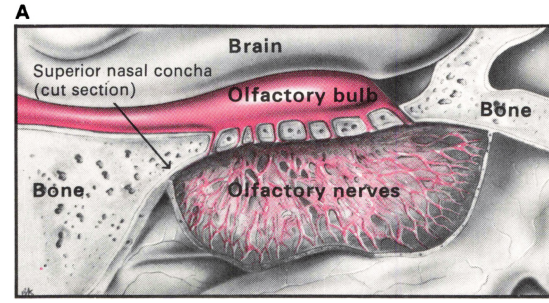


smell to recognize their home territory, animals of their own kind, and other kinds of animals. They also use smell to find food and mates. Insects and some other animals *secrete* (give off) a substance called a *pheromone* in order to communicate by means of smell with their own species. The pheromone secreted by certain female moths can be detected by males of the same species several miles or kilometers away. The scientific term for smell is *olfaction*, and the system by which we smell is known as the *olfactory system*.

How Odors Are Detected. We detect smells by breathing or sniffing air that carries odors. Odors come from molecules of gas that have been released into the air from many different substances. These molecules stimulate *receptor cells* deep inside the nose. The cells, which are part of the olfactory nerves, are on layers of mucus-covered tissue. This tissue covers nasal bones called *conchae*. The receptor cells send the impulses created by the odor along the olfactory nerves.

The olfactory nerves then carry the impulses to a part of the brain called the *olfactory lobe* or *olfactory bulb*. In dogs and some other *vertebrates* (animals with backbones), the olfactory lobe is large, but in man it is small. The size of an animal's olfactory lobe is an indication of how important the sense of smell is to that animal. From the olfactory lobe, the nerve impulses travel to the *forebrain*, the front part of the cerebrum of the brain. Here, the brain translates the nerve impulses it has received into information about the odor.

Scientists do not know exactly how different smells are distinguished. One explanation is that molecules of certain odors become more quickly and more strongly attached to the mucus at a particular place on the conchae than do other molecules. Therefore, molecules of certain kinds of odors will always stimulate the same receptor cells on the conchae. According to this theory, then, an odor is distinguished by how fast and where its molecules become attached to the receptor cells.

Taste and Smell. Generally, we taste and smell food at about the same time. Thus, we have come to think of the two senses as being related. But they are, in fact, separate. Only at some point in the brain are the separate senses combined.

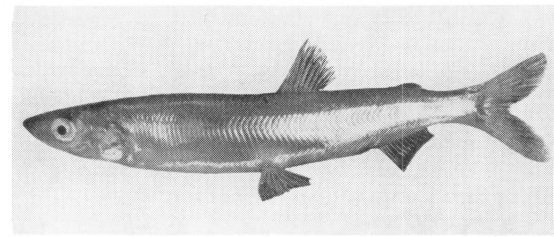
The smell-stimulus parts in food can be separated from the taste-stimulus parts. This can be done by blowing very clean air into the nose at the same time that food is put into the mouth. When this is done, people cannot identify some foods and beverages—for example, chocolate and coffee—though they still taste them. Some substances that are usually thought of as being smells, such as chloroform, have been found to be tastes. BRUCE P. HALPERN

See also DOG (Nose); INSECT (Smell); NOSE; SENSES; TASTE.

SMELLING SALTS are used to relieve faintness and headaches. The salts are made up of ammonium carbonate mixed with perfume. This drug is known as a stimulant.

The ammonia fumes from the salts irritate the membranes of the nose. They also cause the muscles controlling breathing to work faster. AUSTIN EDWARD SMITH

See also AMMONIA.



State of Calif. Dept. of Fish and Game

The Smelt lives on crustaceans, insects, and smaller fishes. The female often lays her eggs on the gravel bottoms of river beds.

SMELT is a family of fishes much like the salmon, but smelts are smaller and have larger scales. Their stomachs also are different from those of the salmon. All smelts live in the cool waters of the Northern Hemisphere. Although they are salt-water fish, some species swim up rivers to spawn. A few species stay in fresh water.

The common *American smelt* swims along the Atlantic Coast between the Gulf of Saint Lawrence and New York. Fishermen trap them in several northern lakes. Men have brought these fish to the Great Lakes, where they have thrived. They are also found in the Pacific Ocean. Smelts enter the streams and rivers to spawn in spring, and can be caught easily with hooks or nets.

The upper part of the smelt's body is a transparent greenish color, and its sides are silvery. The average length of the fish is 8 to 10 inches (20 to 25 centimeters). Some smelts are longer, and weigh about 1 pound (0.5 kilogram).

Smelts are valuable food fish, and large numbers are marketed as frozen fish. The unfrozen, or "green," fish are considered a delicacy.

Scientific Classification. The American smelt is in the smelt family, *Osmeridae*. It is classified as genus *Osmerus*, species *mordax*. CARL L. HUBBS

See also CANDLEFISH.

SMELTING is a method by which metals are taken from their original ore. Smelting is done in specially built furnaces. The blast furnace for making pig iron is as tall as a 10-story building. It operates continuously, day and night. Iron ore, coke, and limestone are fed through the top of the furnace. Hot blast (preheated air) is delivered at the bottom. This burns the coke and generates the gases and heat required to reduce iron from its oxide minerals in the ore, and to melt limestone and unwanted materials in the ore to form *slag*. Molten slag and iron are removed through bottom openings. Furnace gas is removed at the top.

Another type of smelter is the *reverberatory* furnace, which refines copper. In this smelter, the copper sinks to the bottom in a form called *matte*, which contains iron sulfide and sometimes small amounts of other metals. The matte is refined to get copper. GEORGE S. ROSE

See also METALLURGY; BLAST FURNACE; FLUX; IRON AND STEEL (How Iron Is Made); SLAG.

SMETANA, *SMEH tah nah*, **BEDŘICH** (1824-1884), was a leading composer of Bohemia. He tried to produce a Bohemian (Czech) national music based on folk songs and folk dances. He expressed that tendency most clearly in *The Bartered Bride* (1866), one of the greatest of all comic operas. His other operas include *Two Widows* (1873), *The Kiss* (1875-1876), and *The Secret* (1877-1878).

Smetana also composed symphonies. His cycle of six symphonic poems called *My Country* ranks foremost among his orchestral works. *My Country* contains one of Smetana's best-known works, *The Moldau.*

Smetana was born in Litomyšl, Bohemia, near Pardubice. He conducted the Göteborg, Sweden, orchestra from 1856 to 1861, and became conductor of the National Theater in Prague in 1866. He resigned the position in 1874 when he suddenly became deaf. He soon suffered a mental breakdown and was committed to an asylum, where he died. HANS ROSENWALD

SMILAX, *SMY laks,* is a group of woody or herbaceous vines with hardy, tuberous roots and veined evergreen leaves. The stems end in tendrils by which the plants climb. The vines grow in temperate and tropical climates, and bear small clusters of red, blue, or black berries. A well-known American species is the *common greenbrier.* Some species yield *sarsaparilla,* and others have stems that can be worked into baskets. In the South, the roots are sometimes used to make beer and to fatten hogs. See also GREENBRIER.

J. Horace McFarland

Smilax Plant

Scientific Classification. Smilax belongs to the lily family, *Liliaceae.* The common greenbrier is genus *Smilax,* species *S. rotundifolia.* J. J. LEVISON

SMILODON. See PREHISTORIC ANIMAL (The Age of Mammals; color picture).

SMITH, A. J. M. (1902-), is a Canadian poet and scholar. In his poetry, he explores the meaning of life, love, and death. Smith's writing style reflects the influence of the English metaphysical poets of the 1600's (see METAPHYSICAL POETS). His *News of the Phoenix and Other Poems* (1943) won the Governor General's Award. Other collections of Smith's poetry include *A Sort of Ecstasy: Poems New and Selected* (1954) and *Collected Poems* (1962).

Smith has made important contributions to Canadian literature, especially through *The Book of Canadian Poetry: A Critical and Historical Anthology* (1943, revised in 1948 and 1957). This work has strongly influenced critical attitudes toward Canadian poetry and has become a standard college textbook.

Arthur James Marshall Smith was born in Montreal. He joined the English faculty of Michigan State University in 1936. CLAUDE T. BISSELL

SMITH, ADAM (1723-1790), is generally regarded as the founder of modern economics. Smith's major book was *The Wealth of Nations* (full title: *An Inquiry into the Nature and Cause of the Wealth of Nations*). Published in 1776, it was the first complete work on political economy. The book discusses the relationship between freedom and order, analyzes economic processes, and attacks the British mercantile system's limits on free trade (see MERCANTILISM). All three aspects are woven together to create a unified social theory.

The book dealt with the basic problem of how social order and human progress can be possible in a society where individuals follow their own self-interests. Smith argued that this individualism led to order and progress. In order to make money, people produce things that other people are willing to buy. Buyers spend money for those things that they need or want most. When buyers and sellers meet in the market, a pattern of production develops that results in social harmony. Smith said that all this would happen without any conscious control or direction, "as if by an invisible hand."

Smith also believed that labor—not land or money—was both the source and the final measure of value. He said that wages depended on the basic needs of workers, and rent on the productivity of land. Profits, he said, were the difference between selling prices and the cost of labor and rent. Smith said profits would be used to expand production. This expansion would in turn create more jobs, and the national income would grow.

Smith believed that free trade and a self-regulating economy would result in social progress. He criticized the British government's tariffs and other limits on individual freedom in trade. He preached that government need only preserve law and order, enforce justice, defend the nation, and provide for a few social needs that could not be met through the market. Smith's argument for a "hands off" government policy toward business and his analysis of economic forces laid down the basic ideas of *economic liberalism.* See LIBERALISM; FREE ENTERPRISE SYSTEM.

Smith was born in Kirkcaldy, Scotland. He studied at the University of Glasgow and Oxford University. In 1751, he became a professor at Glasgow. He wrote *The Theory of Moral Sentiment* (1759) there. This philosophical work gained Smith an appointment in 1764 as tutor of the young duke of Buccleuch. The tutoring took Smith to France, where he started writing *The Wealth of Nations.* When Smith returned to England in 1766, the duke's stepfather provided Smith with a regular income. The money enabled Smith to retire from teaching and devote the next 10 years to writing. *The Wealth of Nations* went through five editions during Smith's lifetime. But it had little major influence on economic policy until the beginning of the 1800's. DANIEL R. FUSFELD

SMITH, ALFRED EMANUEL (1873-1944), was an American political leader. He was elected governor of New York four times, and in 1928 was an unsuccessful candidate for President of the United States.

Smith became active in politics at the age of 22. He worked his way up in the Tammany Hall machine to become one of the leaders of the Democratic Party. He was elected to the state legislature in 1903, and became governor of New York in 1919.

Wide World

Alfred E. Smith

Smith failed to win the Democratic Party's nomination for President in 1924. But four years later, he won the nomination with the help of his friend and associate, Franklin D. Roosevelt. The *Happy Warrior,* as Roosevelt called him, lost the election to Herbert Hoover. Some

people opposed Smith because he was a Roman Catholic and because he opposed prohibition. At the start of the depression of the 1930's, Smith supported federal spending. Later, he broke with Roosevelt, and became critical of New Deal policies (see NEW DEAL).

Smith was born in New York City. He left school at the age of 12, and worked first as a newsboy. Later he worked seven years in the Fulton Fish Market of New York City. GEORGE M. WALLER

SMITH, BESSIE (1894-1937), became one of the finest blues singers in the history of jazz. A series of recordings she made from 1923 to 1933 rank among the best in jazz. In them, she applied the strength and beauty of her voice to simple songs. Louis Armstrong, Fletcher Henderson, Joe Smith, and James P. Johnson were among the jazz musicians who played on her records.

Bessie Smith was born in Chattanooga, Tenn., into extreme poverty. She left home when she was a teenager to tour with a minstrel show. A recording director discovered her and brought her to New York City. The Negro public bought millions of her records during the years of her greatest fame from 1923 to 1928. Her work was almost unknown to white audiences until shortly before her death. Miss Smith died of injuries suffered in an automobile accident in Mississippi. LEONARD FEATHER

SMITH, DAVID (1906-1965), was an American sculptor who worked with metals in many forms. His most typical works are muscular metaphors resembling hieroglyphics in wrought iron. His work has influenced sculptors who create their work out of junk materials. Smith's *Cubi XIX* appears in the SCULPTURE article.

Smith was born in Decatur, Ind. While working on a Studebaker automobile plant assembly line, he learned the metal techniques he used in his later work. In 1926, Smith went to New York City to study at the Art Students League. He began to create welded iron works after seeing Picasso's welded sculpture and the forged iron constructions of Julio González of Spain in the early 1930's. DOUGLAS GEORGE

SMITH, DONALD ALEXANDER. See STRATHCONA AND MOUNT ROYAL, BARON OF.

SMITH, EDMUND KIRBY (1824-1893), was a Confederate general in the Civil War. He commanded troops in the first Battle of Bull Run (Manassas) and in the Kentucky campaign in 1862. The next year, he became commander of the Confederate Trans-Mississippi Department. He was promoted to general in 1864. Smith was the last Confederate general to surrender after the Civil War ended in 1865.

Smith was born in St. Augustine, Fla. He received his mother's maiden name, Kirby, as his middle name. A generation later, the family name became Kirby-Smith. Smith graduated from the United States Military Academy, and fought in the Mexican War. A statue of Smith represents Florida in the United States Capitol in Washington, D.C. FRANK E. VANDIVER

SMITH, FREDERICK M. See LATTER DAY SAINTS, REORGANIZED CHURCH OF JESUS CHRIST OF.

SMITH, HOLLAND MCTYEIRE. See WORLD WAR II (Saipan).

SMITH, IAN DOUGLAS (1919-), became prime minister of Rhodesia in 1964. He sought independence from Great Britain under a constitution that would allow Rhodesia's white minority to govern the African majority indefinitely. Britain refused to grant independence on these terms, and Smith declared Rhodesia independent without Britain's consent on Nov. 11, 1965.

Born in Selukwe, Rhodesia, Smith graduated from South Africa's Rhodes University. He was a member of Southern Rhodesia's parliament from 1948 to 1953, and of the Federation of Rhodesia and Nyasaland federal assembly from 1953 to 1961. Elected to the Rhodesian parliament in 1962, Smith was deputy prime minister and treasury minister until 1964. KENNETH KIRKWOOD

SMITH, JAMES (1719?-1806), was a Pennsylvania signer of the Declaration of Independence. He urged a boycott of British goods and a general congress of colonies when he was a delegate to a conference in Philadelphia in 1774. He helped draft a resolution for independence at the provincial conference in June, 1776. He served in the Continental Congress from 1776 to 1778 and as judge of the Pennsylvania High Court of Errors and Appeals in 1781. He was born in Ireland, and came to Pennsylvania as a boy. RICHARD B. MORRIS

SMITH, JAMES, JR. See WILSON, WOODROW (Governor of New Jersey).

SMITH, JEDEDIAH STRONG (1799?-1831), was an American trader and explorer. As a young man, he entered the fur trade in the West. He set out in 1826 to find trade routes to California and the Northwest. From the Great Salt Lake, he crossed Ute and Paiute Indian territories, the Mojave Desert, and the High Sierras, until he reached Mission San Gabriel in California. But the Spaniards ordered him out. He started north to find a pass across the Sierra Nevada. While returning to California the next year, Indians killed 10 of his party. Smith escaped. In 1828, he led an expedition to Fort Vancouver (now Vancouver, Wash.), but an Indian attack along the way wiped out most of his party. Smith was born in Bainbridge, N.Y. He was killed by Indians on the Santa Fe Trail. RICHARD F. DEMPEWOLFF

SMITH, JOHN (1580-1631), was an English soldier and adventurer. He played a vital role in founding Virginia and New England (see VIRGINIA [History]).

Smith sailed in the squadron of three ships that established the first permanent English colony in America in 1607 at Jamestown, Va. He was accused of mutiny, but later was admitted to the ruling council. Largely because of his energy, the colony built up its defenses against hostile Indians and gathered enough corn from trading to survive the first desperate winter (see JAMESTOWN). Smith explored the nearby rivers and made a fine map that was used later to determine the boundaries of the colonies. According to a story Smith told, Indians captured him while he was on an expedition, and condemned him to death. But Pocahontas, the daughter of an Indian chief, saved him (see POCAHONTAS; POWHATAN).

Smith became president of the colony in 1608. He forced his men to work to save themselves from starvation. Gravely wounded in a gunpowder accident and opposed by enemies within the colony, Smith sailed for England in 1609.

He returned to America in 1614 and explored and named New England. He described the region in his book, *A Description of New England*. Smith hoped to establish a permanent colony in Massachusetts Bay, but bad luck prevented him.

Smith was born in Willoughby, Lincolnshire. He attended grammar school and was apprenticed to a merchant. But his thirst for adventure sent him to The Netherlands to fight the Spaniards. He returned to England only long enough to master the art of military horsemanship, and then went to fight the Turks in Hungary. He was left for dead on a battlefield, and then taken as a slave to Turkey. He later escaped.

Smith spent his later years writing in London. He wrote about his exploits in *The True Travels, Adventures, and Observations of Captaine John Smith, in Europe, Asia, Africa, and America* (1630). These adventures, though once doubted, were confirmed by careful research. His principal work is *The Generall Historie of Virginia, New England and the Summer Isles* (1624). He is called *Admiral of New England* on the title page, but authority for the title never has been found. BRADFORD SMITH

SMITH, JOHN MERLIN POWIS. See BIBLE (Other Modern Versions).

SMITH, JOSEPH (1805-1844), was the founder and first president of the Mormon Church, officially called the CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS. Several other churches recognize him as their founder. The largest of these is the Reorganized Church of Jesus Christ of Latter Day Saints. Those who follow Smith's teachings regard Smith as a prophet of God.

Early Life. Smith was born in Sharon, Vt., on Dec. 23, 1805, the fourth of ten children. The Smiths met with hard times in Vermont. When Joseph was 11, his parents, Joseph and Lucy Mack Smith, moved the family to Manchester, N.Y., near Palmyra.

Young Joseph Smith was troubled by the counterclaims made by religious groups of his day. He could not decide which to join. In 1820, he went alone into the woods to seek God's guidance. According to his account, God the Father and His Son (Jesus Christ) appeared to him. They told him not to join any existing church and to prepare for important tasks.

Smith said the angel Moroni visited him in 1823, and told him he would receive gold plates on which he would find a book engraved in a strange language. Smith said he received the plates in 1827. His translation of the writings, called the *Book of Mormon*, was published in 1830. The book is a history of early peoples of the Western Hemisphere. Mormons and other followers of Joseph Smith believe the book was divinely inspired. They regard it as holy scripture.

Organizing the Church. On April 6, 1830, Smith and five associates founded the Church of Jesus Christ of Latter-day Saints at Fayette, N.Y., with Joseph Smith as its leader. Smith moved to Kirtland, Ohio, in 1831, and made many converts there. The Mormons also established communities in Mentor, Ohio, and Independence, Mo.

Smith instituted many of the church's present doctrines and its basic organization at Kirtland. He organized the *quorums* (groups) of the priesthood, which gave most male church members priestly authority. Later, in Missouri in 1838, he introduced *tithing* (giving one-tenth of one's income to the church).

In Kirtland, the church faced many problems. A bank established by the Mormons failed in 1837, a year of national economic depression. The bank failure, opposition from persons who had left the church, and conflict with non-Mormons led to the breakup of the Kirtland community. Smith joined the Mormons in Missouri in 1838. There, hostilities arose between Mormons and non-Mormons. Non-Mormons feared the increasing size of the Mormon community and opposed their anti-slavery beliefs. The hostilities led to the outbreak of an armed conflict. Smith led the Mormons in their effort to defend themselves. The outnumbered Mormons surrendered, and Smith was imprisoned on what the Mormons regard as false charges. He escaped a few months later and joined his people who had fled from Missouri to Illinois.

Bettmann Archive

Joseph Smith claimed that the angel Moroni appeared to him in a vision and told him where to find the *Book of Mormon* plates.

Life at Nauvoo. Joseph Smith and the Mormons founded the city of Nauvoo (*the plantation beautiful*) in Illinois. Nauvoo's population reached 20,000 in the early 1840's, making it the largest city in the state. By that time, Smith headed a church with thousands of members. He was mayor of Nauvoo and a successful businessman. He headed the *Nauvoo Legion*, a small army authorized by the state to protect the community. The rapid growth of the Mormon church had political significance. In 1844, the year he was killed, Joseph Smith declared himself a candidate for President of the United States to rally public opinion for Mormon defense.

Smith instituted the doctrine of *polygamy* at Nauvoo in 1843. Polygamy is the practice of a man having more than one wife at the same time. Most non-Mormons and many Mormons disagreed with this practice. The church finally outlawed polygamy in 1890. Some members who did not agree with the doctrine of polygamy broke away

in 1844. They set up a newspaper that criticized Smith. The paper was destroyed, and Smith was blamed for it. This caused a wave of hostility against him in Illinois. He and his brother Hyrum were jailed at Carthage, Ill., on charges of rioting and treason which the Mormons felt were false. A mob attacked the jail and killed the brothers on June 27, 1844. But the church continued to grow after Joseph Smith's death. Brigham Young led the main body of Mormons to present-day Utah, where they prospered.

In addition to the *Book of Mormon*, Smith wrote the *Pearl of Great Price* (1830, 1835) and *Doctrine and Covenants* (1835) based on his revelations. He wrote an autobiography in 1842. MARK E. PETERSEN

See also MORMONS; LATTER DAY SAINTS, REORGANIZED CHURCH OF JESUS CHRIST OF; UTAH (History); ILLINOIS (Places to Visit [Nauvoo]).

SMITH, JOSEPH F. (1838-1918), was the sixth president of the Church of Jesus Christ of Latter-day Saints (the Mormon Church). His uncle Joseph Smith founded the church (see SMITH, JOSEPH). Joseph F. Smith became church president in 1901. He showed little interest in theology and doctrine. But he helped the Mormons by paying off their debts and by starting a building program. He was born in Far West, Mo. Smith's early life was tragic. His father, Hyrum, and his uncle Joseph were murdered when he was 5. Several years later, he went to Utah with the Mormons. His full name was Joseph Fielding Smith. NORMAN F. FURNISS

SMITH, MARGARET CHASE (1897-), was the first woman to be elected to both houses of the United States Congress. Her husband was a Republican congressman from Maine. When he died in 1940, Mrs. Smith replaced him in the U.S. House of Representatives. She served four full 2-year terms. She was elected to the U.S. Senate in 1948 and was re-elected three times. She served in the Senate from 1949 to 1973. In 1950, she became one of the first senators to oppose tactics used by Wisconsin Senator Joseph R. McCarthy. In 1964, Mrs. Smith campaigned for the Republican presidential nomination, the first woman ever to do so for a major party. She was born Margaret Madeline Chase in Skowhegan, Maine. ERIC SEVAREID

SMITH, SAMUEL FRANCIS (1808-1895), an American clergyman, editor, and poet, wrote the words to the patriotic hymn "America" (1831). He was born in Boston, Mass., and was graduated from Harvard University in 1829, and Andover Theological Seminary in 1832. He was ordained a Baptist minister in 1834. Smith served as pastor at Waterville, Me., and as a professor of modern languages at Waterville College until 1842. He edited *The Christian Review* magazine from 1842 to 1848. EARLE E. CAIRNS

See also AMERICA.

SMITH, THEOBALD (1859-1934), was an American investigator of diseases in both human beings and domestic animals. In 1886, he separated the microbes of swine plague from those of hog cholera and showed how to prevent hog cholera. He helped discover the cause of Texas fever in cattle by proving that microbes were carried by ticks. These findings saved the southern beef-cattle industry and established the science of insect-borne diseases (see CATTLE TICK). Smith also announced that tuberculosis in cattle and tuberculosis in humans is not caused by the same organism.

Smith was born in Albany, N.Y., and was educated at Cornell University and Albany Medical College. He was head of animal pathology at the Rockefeller Institute for Medical Research (now Rockefeiler University) until 1929. STANLEY E. WEDBERG

SMITH, WILLIAM (1769-1839), an English geologist and engineer, was the first scientist to use fossils to identify and also determine the relative age of rock *strata* (layers). Smith discovered in the late 1700's that each layer of rock contained its own characteristic fossils. He noticed that the fossils in the various layers were arranged according to chronological sequence. Thus, Smith could tell the age of strata in relation to one another. He also noted that fossils in any layer change little from one location to another. Therefore, Smith could trace and compare the strata of widely separated areas.

Smith used fossils to draw a geological map of England that showed strata of different ages underlying the entire country. This map was one of the first attempts to show the relation between rock formations in any large area. Today, geologists use fossils as a primary means of identifying rock strata. R. H. DOTT, JR.

SMITH ACT, or ALIEN REGISTRATION ACT OF 1940, makes it a crime to advocate the violent overthrow of the United States government or to belong knowingly to a group advocating it. In 1951, the Supreme Court upheld the act in the case of 11 convicted leaders of the Communist Party. But in 1957, it ruled that Communist Party membership was not, in itself, grounds for conviction. Proof was required that a defendant himself had urged violent revolution. In 1961, the Supreme Court again upheld the conviction of a member of the Communist Party under the act. The court maintained that in this case the person had been an active party member and had intended to overthrow the government of the United States.

SMITH COLLEGE is a privately controlled college in Northampton, Mass. Its undergraduate school admits only women, but its graduate school is coeducational. Smith grants bachelor's, master's, and doctor's degrees. Undergraduates take liberal arts programs. Graduate students may take programs in arts, education, education of the deaf, fine arts, philosophy, physical education, or social work. Smith also participates in a cooperative doctoral degree program with the University of Massachusetts and Amherst, Hampshire, and Mount Holyoke colleges. At Smith, qualified juniors and seniors may participate in an honors program of specialized study. Juniors may study abroad.

Smith was founded in 1871. For enrollment, see UNIVERSITIES AND COLLEGES (table). RUSSELL F. CARPENTER

SMITH-HUGHES ACT, also known as the VOCATIONAL EDUCATIONAL ACT, provides federal funds to the states for vocational education. The payments are used for training in agriculture, home economics, and trades and industries. To be eligible, states must submit plans to the federal government for approval. The act was adopted by the U.S. Congress in 1917. Since then, Congress has passed additional acts for vocational rehabilitation programs. THOMAS J. MCLERNON

See also AGRICULTURAL EDUCATION; FUTURE FARMERS OF AMERICA (History).

SMITH-LEVER ACT. See AGRICULTURAL EDUCATION (Cooperative Extension Work).

SMITHSON, JAMES (1765-1829), a British scientist, founded the Smithsonian Institution. In his will he gave more than $500,000 to the United States for the establishment of a scientific institution. Congress accepted this gift and in 1846 created the Smithsonian Institution at Washington, D.C.

Smithson was born in France, and was educated at Oxford University. Smithson became known for his researches in chemistry and mineralogy. One of the many minerals that he studied was named *smithsonite* (zinc carbonate) in his honor. HENRY M. LEICESTER

See also SMITHSONIAN INSTITUTION.

SMITHSONIAN INSTITUTION is a federally chartered nonprofit corporation of scientific, educational, and cultural interests in Washington, D.C. James Smithson, a British scientist, left his fortune to the United States in 1829 to found an establishment for the "increase and diffusion of knowledge among men." The U.S. Congress established the Smithsonian on August 10, 1846.

Administration. A board of regents governs the institution. It consists of the Chief Justice and the Vice-President of the United States, three members each of the U.S. Senate and the House of Representatives, and nine private citizens appointed by joint resolution of Congress. The secretary of the institution acts as executive officer and directs its activities.

Activities. The Smithsonian conducts scientific research and publishes the results of studies, explorations, and investigations. It preserves and displays items representing the arts, American history, aeronautics and space exploration, science and technology, and natural history. It engages in educational programs. Major programs include the following.

The *National Gallery of Art* maintains a collection of paintings, sculpture, and the graphic arts representative of the best in the artistic heritage of America and Europe. The *National Collection of Fine Arts* surveys American art from colonial times to today. The *National Portrait Gallery* exhibits likenesses of persons who have contributed significantly to the history, development, and culture of the people of the United States. The *Freer Gallery of Art* displays masterpieces of Near and Far Eastern art, early Christian manuscripts, and works by the American painter James McNeill Whistler. The *Hirshhorn Museum and Sculpture Garden* emphasizes art of the 1900's. The *Cooper-Hewitt Museum of Decorative Arts and Design* in New York City maintains a collection of more than 85,000 items of decorative art.

The *National Zoological Park* contains about 3,000 living mammals, birds, and reptiles representing over 800 species. The *National Museum of Natural History* has exhibits and conducts research on man, animals, plants, fossils, minerals, and objects from outer space. The *National Museum of History and Technology* houses collections representing American cultural, civil, and military history, as well as scientific and technological advances. The *National Air and Space Museum* records U.S. air and space flight developments.

The *Smithsonian Astrophysical Observatory* in Cambridge, Mass., conducts research in astrophysics, space science, and earth physics. The observatory maintains stations throughout the world for tracking artificial earth satellites. The *Radiation Biology Laboratory* at Rockville, Md., studies basic problems of radiation biology at the cellular, subcellular, and molecular levels. For example, it measures the effects of solar radiation on plant and animal growth. The *Smithsonian Tropical Research Institute* in the Panama Canal Zone studies tropical biology, especially the evolution of behavior patterns and ecological adaptations among marine and land wildlife.

The *International Exchange Service* is the official U.S. agency for the international exchange of scientific and scholarly publications. The *Smithsonian Science Information Exchange, Inc.*, receives, organizes, and disseminates information about contemporary research in the life sciences, physical sciences, and social sciences. The *Woodrow Wilson International Center for Scholars* was established by Congress to be the nation's official memorial to the 28th President. Its fellowship program is devoted to scholarships on contemporary and emerging issues, and to fostering closer ties between scholars and statesmen.

The *John F. Kennedy Center for the Performing Arts* in Washington, D.C., is a national cultural center and memorial to President John F. Kennedy. It presents concerts, operas, plays, dance, lectures, and other programs. Critically reviewed by SMITHSONIAN INSTITUTION

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Smithson, James
Washington, D.C. (Smithsonian Museums)

SMITHSONITE. See ZINC.

SMOG is a form of air pollution. The term was first used to describe the combination of *sm*oke and *fog* that sometimes hangs over London and other cities with high humidity. Today, smog also refers to a condition caused by the action of sunlight on the exhaust gases from automobiles, homes, and factories. This type of smog is sometimes called *photochemical smog*.

Weather conditions may cause smog to collect in an area. Such conditions include a lack of wind or a layer of cool air near the ground with a warm layer over it. Mountain ranges near cities may also trap smog in an area. Heavy concentrations of smog are poisonous. In 1948, 20 persons died and nearly 6,000 became ill from a photochemical smog over Donora, Pa. About 4,000 Londoners died within five days as a result of a thick smog in 1952. Smog also destroys plant life and causes building materials to deteriorate faster than usual.

London-Type Smog occurs when moisture in air condenses on smoke particles from factories, homes, and motor vehicles, forming tiny smog droplets. A dangerous part of London-type smog is sulfur dioxide, a gas that attacks the lungs and makes breathing difficult.

Photochemical Smog involves the action of sunlight on *hydrocarbons* in the air. Hydrocarbons are chemicals found in the exhaust gas of gasoline, oil, and other petroleum products burned as fuel. The heat produced by burning these fuels causes nitrogen and oxygen in the air to combine, forming nitrogen compounds. When activated by sunlight, these compounds undergo

changes that produce gases called *oxidants*. One of these oxidants, *ozone*, can kill plants and irritate a person's eyes, nose, and throat. Oxidants also combine with the partially burned hydrocarbons in the air. One of the substances that result is called *peroxyacetyl nitrate* (PAN). This substance is the chief poisonous product of photochemical smog. ROBERT G. KNOLLENBERG

See also AIR POLLUTION; OZONE.

SMOKE occurs when finely divided solid particles become *suspended* (mixed) in a gas. A mixture of fog and smoke is *smog* (see SMOG). Most smoke is caused by particles of carbon from the burning of fuels. Smoke is bad for the health. The most dangerous accumulation of smoke occurs with a weather condition called *inversion*. In this type of weather, no vertical air currents exist to remove the smoke or smog. Smoke causes huge economic losses by blackening buildings, corroding metals, and damaging plants. The annual loss because of smoke in the United States is about $1 billion. A few helpful uses for smoke include colored military signals, curing meats, and protection of orchards with smudge pots during freezes. See also AIR POLLUTION; ENVIRONMENTAL POLLUTION; SMUDGE POT. WALTER J. MOORE

SMOKE PREVENTION is a task many communities face. They try to keep the air free from smoke. Smoke is a great nuisance in cities, where there are many furnaces, incinerators, and other smoke-producing devices. Smoke is harmful both to man and to plant life.

Smoke is a mixture that comes from burning any kind of material, such as coal, wood, or petroleum. Smoke is made up of water vapor, carbon dioxide, and other gases that cannot be seen. Yet smoke itself can be seen clearly, because it contains many tiny particles of unburned carbon. These black particles are known as *soot*. In some cities, 100,000 short tons (91,000 metric tons) of soot come from chimneys each year.

Smoke Harms Health because of its effect on the nose, throat, and lungs. Smoke-filled air increases sinus trouble, nose trouble, tuberculosis, and pneumonia. Smoke also makes cities look dark and cuts out much sunlight. Sulfuric acid, a chemical in smoke, poisons plant life. Smoke harms the outside of buildings and causes metals to wear away. People spend millions of dollars each year to clean smoke stains and soot smudges from clothes, curtains, and furniture.

Burning soft coal causes much of the smoke problem. To remedy this, many cities have changed to burning hard coal, fuel oil, natural gas, and coke. Engineers have designed better furnaces. They also have tried to teach people how to make a fire properly. These steps reduce the amount of soot. Engineers have developed an automatic stoker that feeds fires no faster than the coal is burned. Special fans and flues have been made to give furnaces the right kind of drafts.

Preventive Measures. Smoke once formed by incomplete combustion cannot be consumed. The only effective way to prevent the formation of sooty smoke is by improving the ways of burning fuel.

Many cities have laws intended to reduce the amount of smoke. In some cities, such as New York City, all railway trains within the city limits must use electricity. Some other cities permit only certain types of coal to be burned. The California legislature has passed a law requiring that each new automobile registered in the state must use an approved smoke-reducing device on its exhaust system. E. A. FESSENDEN

See also COLLOID; SOOT; SMOG.

SMOKE SCREEN. See BOMB (Other Types of Bombs).

SMOKE SIGNAL. See INDIAN, AMERICAN (Language).

SMOKED FOOD. See FOOD PRESERVATION (Curing; picture); FISHING INDUSTRY (Processing).

SMOKELESS POWDER. See GUNPOWDER (History).

SMOKING is the drawing of tobacco smoke from a cigarette, a cigar, or a pipe into the mouth—and often into the lungs—and puffing it out. The term usually refers to the inhalation of cigarette smoke, the most common form of smoking.

Medical studies have shown that smoking is a great health hazard because of its effects on the body. These studies show that the average life expectancy of a smoker is three to four years less than that of a nonsmoker. The life expectancy of a heavy smoker—a person who smokes two or more packages of cigarettes a day—may be as much as eight years shorter than that of a nonsmoker.

In the United States, about 80 per cent of the adult males and 50 per cent of the adult females smoke or have smoked regularly in the past. From 1930 to 1960, cigarette smoking by adult men increased about 500 per cent. But since 1964, when the U.S. surgeon general first officially warned of the health hazards of smoking, the number of smokers in the United States has declined.

Why Smoking Is Dangerous. Smoking has significant effects on the body because of (1) the nicotine in tobacco, (2) the tars in tobacco, and (3) smoke particles that are trapped in the lungs.

Nicotine acts as a stimulant on the nervous system and the heart and other internal organs. Its effect on the nervous system is one of the reasons why people have such a hard time giving up smoking. Nicotine is poisonous. It may be the cause or one of the causes of the many heart attacks and other conditions, including stomach and intestinal ulcer, that are related to smoking. See NICOTINE.

Tars contain small quantities of *carcinogenic* (cancer producing) substances. They are believed to be one of the major factors that lead to lung cancer and other types of cancer among smokers.

Smoke Particles are as small as $\frac{1}{70,000}$ inch (0.00036 millimeter). A smoker exhales most of the particles, but as many as 25 per cent of them may be trapped on the lining of the lungs. The particles are later absorbed by cells in the lining. This absorption may cause the cells to function improperly and damage the lining of the lung. The particles can also cause excessive scar tissue within the walls of the lungs. Smoke particles probably help cause progressive destruction of the walls of the air sacs in the lungs of long-term smokers.

Smoking and Disease. In the late 1950's, the American Cancer Society conducted a four-year study of the effects of smoking on 187,000 men. Some of the men were smokers and others were not. The smokers represented a wide range of smoking habits. Some smoked only pipes and cigars. Others smoked from half a pack of cigarettes to two packs a day.

The study showed that 30 per cent more smokers died of coronary heart attacks than would have been expected to die. Lung cancer caused an 8 per cent

increase in the death rate among smokers. Other lung diseases, including bronchiectasis, emphysema, pneumonia, and tuberculosis, increased the death rate another 3 per cent. All other diseases, including cirrhosis of the liver, stomach cancer, and stomach ulcer, caused still another 16 per cent increase in the death rate. If all these figures are combined, they show a 57 per cent increase in the death rate among smokers for any year of the study.

Many smokers develop emphysema, a disease that destroys the walls of the air sacs of the lungs. Emphysema reduces the surface area of the lungs through which oxygen and carbon dioxide can pass, causing serious shortness of breath. ARTHUR C. GUYTON

See also TOBACCO (Effects of Using Tobacco).

SMOKY MOUNTAINS, GREAT. See GREAT SMOKY MOUNTAINS.

SMOLENSK, *smoh LENSK* (pop. 216,000), is one of the oldest cities of western Russia. It lies on the Dnepr River, about 275 miles (443 kilometers) southwest of Moscow (see RUSSIA [political map]). It is a railroad junction on the main east-west line across Russia. It produces linen goods, textile machines, and road-building equipment. During World War II, Smolensk was severely damaged. THEODORE SHABAD

SMOLLETT, *SMAHL et,* **TOBIAS GEORGE** (1721-1771), was one of the great early English novelists. He was born near Dumbarton, Scotland, and became a doctor. After an adventurous life at sea as a ship's doctor, he settled in London. Smollett's first two novels, *The Adventures of Roderick Random* (1748) and *The Adventures of Peregrine Pickle* (1751), draw heavily on his sea experiences. *The Expedition of Humphry Clinker* (1771) is generally considered his best novel. Told in letters, it gives a vivid picture of a family traveling through England and Scotland.

Smollett's novels are loosely constructed accounts of amusing and sometimes vulgar incidents in the hero's life. They are read for their eccentric characters, for their bitter social satire, and for their broadly comic high spirits. IAN WATT

SMOOT, REED (1862-1941), served as a Republican United States senator from Utah from 1903 to 1933. For many years, he was chairman of the Senate Finance Committee. Tax and tariff problems were his special assignments, and he was coauthor of the Smoot-Hawley tariff law in 1930. American protectionists liked the high rates of the law, but many economists criticized it. Smoot strongly supported programs to promote economy and efficiency in government.

Smoot also was one of the leaders of the Church of Jesus Christ of Latter-day Saints (Mormons). He became an apostle in that church in 1900. Smoot was born in Salt Lake City, Utah. He was graduated from Brigham Young Academy in Provo, Utah. NELSON M. BLAKE

SMOOT-HAWLEY TARIFF LAW. See SMOOT, REED; HOOVER, HERBERT CLARK (Champion of Prosperity).

SMOOTH-COATED FOX TERRIER. See FOX TERRIER.

SMÖRGÅSBORD, *SMAWRgus BOARD,* or *SMUR gohs BAWRD,* is an informal Scandinavian meal noted for its variety. It includes many kinds of appetizers, such as smoked and pickled fish, tongue, sweetmeats, spiced fruits, vegetables, and salads. The food is spread on a table, and each person fills his plate.

See also SWEDEN (Food).

SMUDGE POT contains a smoldering fire used to protect plants and early-blooming fruit trees from killing frosts. Smoke does not spread heat readily. Therefore, commercial growers place a layer of smoke over vegetation when frost is forming. Smoke from nearly any fuel can be used for a smudge pot. Hay, damp leaves, old rubber, and oil waste may be burned in it.

Oil-burning heaters, which warm the air directly, have almost entirely replaced smudge pots. These heaters raise the air temperature about 8 degrees Fahrenheit (4 degrees Celsius). To protect citrus fruits on cold nights, 20 to 100 heaters per acre (49 to 250 heaters per hectare) are needed. HENRY T. NORTHEN

SMUGGLING is the illegal transportation of people or goods into or out of a country or area. People who smuggle goods are usually trying to avoid the payment of *customs duties,* or taxes (see TARIFF). Most countries have customs officers stationed at seaports and at various points on their borders. These officers examine shipments of merchandise and the personal baggage of travelers to make sure that customs duties are paid.

Sometimes a country may have laws prohibiting the importation of a particular article. For example, the United States once prohibited the importing of alcoholic liquors. Violation of such laws also is called smuggling. During prohibition in the United States, people sometimes referred to the illegal manufacture, sale, or transportation of alcoholic liquors as *bootlegging.*

Persons who are guilty of smuggling may be punished by fines, imprisonment, or by having the goods taken, according to the seriousness of the offense. In the United States, no one is held guilty of smuggling unless he has acted intentionally. FRED E. INBAU

SMUT is a fungus that lives as a parasite in certain plants and causes diseases in them. Smut gets its name from the fact that it produces tiny black spores that look like particles of soot. Smuts are dangerous to both cultivated and wild plants. They are particularly harmful to agricultural crops such as wheat, oats, barley, corn, and rice. Smuts usually destroy the seeds or entire clusters of flowers. This may result in the plant's becoming completely useless or unable to produce seeds.

One of the most common of all smuts is the *corn smut.* This smut causes a huge loss of corn each year. It usually grows on the ears of corn plants, causing large growths that resemble boils. Sometimes these growths also occur on the tassels. The spores of corn smut may live in the soil, or in manure that has come from animals fed with infected corn stalks. These spores may later infect plants with which they come in contact. As the corn plant develops, the tiny threads of smut grow within the tissues of the plant. These threads produce large blotches of dark-brown spores in the ears, the tassels, and sometimes in the leaves of the corn plant.

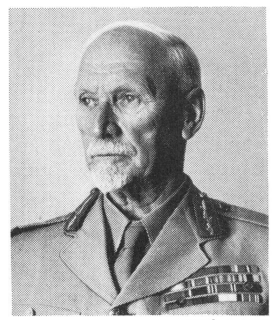
The best way to prevent corn smut is by *rotation of crops.* This means to change the location of the crops planted each year. This helps to prevent smut because the spores do not usually live in the soil for more than a year. It also is desirable that all plants that are affected with smut be destroyed in order to prevent the transfer of the infection.

The *oat smuts, stinking smut* of wheat, and the *covered smut* of barley are three common smuts which are dan-

gerous to cereal crops. The spores of these smuts are dusted on the outside of the seeds when the crop is threshed. *Threshing* means the separation of the seed from the straw. When seeds carrying smut spores are sown, the spores sprout and infect the young seedlings. The spores can be destroyed by treating the seeds with a disinfecting solution, such as *copper sulfate* or *formalin*. Some mercury dusts also destroy smut spores on seeds.

Although most of the best-known smuts cause serious damage to agricultural crops, there are a few kinds of smuts that improve the taste of certain edible plants. Some smuts can be grown in culture in the laboratory in the same way as yeast cultures. WILLIAM F. HANNA

SMUTS, JAN CHRISTIAAN (1870-1950), was a South African soldier, scholar, and statesman. He fought against Great Britain in the Boer War, but he later followed a policy of reconciling the Boers (Dutch settlers) and the British.



Rosenthal, Pix

Jan Christiaan Smuts

Smuts was born in Cape Town of an old Dutch family. He studied law at Cambridge University. He returned to Cape Town to study law, and became state attorney of the Transvaal Republic. When war broke out with Great Britain in 1899, Smuts received a command in the Boer Army and became a skillful military leader (see BOER WAR). He rose to the rank of general in that war.

In 1906, Great Britain gave the Transvaal self-rule, and Smuts worked hard for the union of the South African colonies. When the Union of South Africa was formed in 1910, Smuts became minister of the interior under Prime Minister Louis Botha (see BOTHA, LOUIS). Smuts later served as minister of defense, minister of finance, and minister of justice.

During World War I, Smuts fought for Great Britain, and served in London as a member of the British War Cabinet. At the Paris Peace Conference, Smuts became one of the authors of the Covenant of the League of Nations. When Botha died in 1919, Smuts became prime minister of the Union of South Africa.

The Nationalist party defeated Smuts in 1924. James Hertzog, the Nationalist leader, formed a coalition in 1933, with Smuts second in command. Smuts again became prime minister in 1939 on the platform of aiding Great Britain against Nazi Germany. During World War II, he became a British field marshal. In 1945, Smuts was mainly responsible for drafting the Preamble to the Charter of the United Nations.

Smuts was a champion of internationalism. He was an intellectual known for philosophic writings and profound speeches. He favored a more liberal policy for the Negroes of his nation. Smuts resigned in 1948 after the Nationalists defeated his party. T. WALTER WALLBANK

See also SOUTH AFRICA (History); UNITED NATIONS (The Preamble).

SMYRNA. See IZMIR.

SMYTH, JOHN. See BAPTISTS (History).

SNAIL is an animal whose soft body is usually covered with a coiled shell. A snail creeps along on a strong muscular organ called a *foot*. Its body has a head with *tentacles* (feelers), eyes, a mouth, and tiny teeth. There are more than 80,000 kinds of snails. Some are as small as a pinhead. Others grow 2 feet (61 centimeters) long.

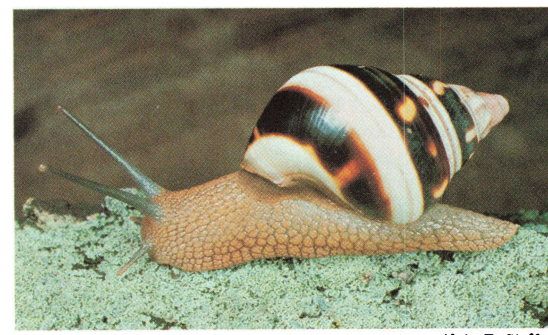
Snails live almost everywhere—in forests, deserts, rivers, ponds, and all parts of the ocean. They eat many kinds of food. Many snails that live on land eat rotting plants. Snails that live in rivers and lakes feed on water plants and dead animals. Some ocean snails feed on seaweeds, and some eat other sea animals. A few ocean snails are *parasites*, and live in the flesh of starfish or inside living sea animals called corals. Snails may live from 2 to 20 years.

Snails that live on land have both male and female sex organs in the same animal. Most of those that live in water are either male or female.

Groups of Snails. Snails can be divided into three groups, according to where they live: on *land*, in *fresh water*, or in *salt water*.

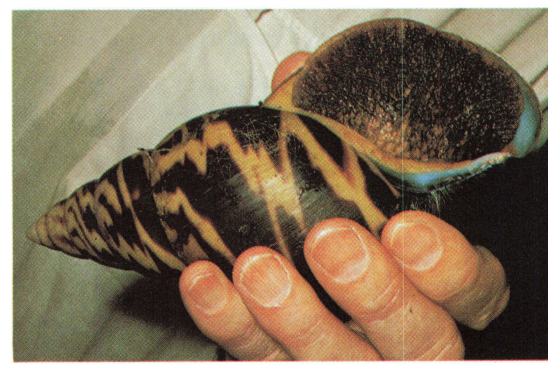
Land snails are found in damp, shady places—under logs and stones, at the edges of ponds and rivers, and in woods. Most land snails live on the ground. But in tropical forests, many large, colorful kinds are found in the trees. Most land snails have lungs.

The land snail uses its muscular foot to crawl about. The muscles of its foot move in a backward, wavelike



Alvin E. Staffan

The Florida Tree Snail has wide, colorful stripes around its shell. Like other land snails, it uses dried mucus to seal itself within its shell in dry weather.



E. S. Ross

The Giant African Snail, one of the largest snails, grows about 6 inches (15 centimeters) long. Farmers consider this snail a serious pest because it destroys many kinds of plants.

motion that pushes the snail forward. A moving snail pours out a sticky liquid called *mucus*, which serves as a path. The snail's enemies, beetles and ants, sometimes get caught in the mucus. During dry weather, the snail seals itself inside its shell with a "door" of dried mucus, called an *epiphragm*. It rests in this inactive condition, called *estivation*, until the dry spell ends.

Fresh-water snails live in rivers, ponds, lakes, and hot springs. There are about 5,000 kinds of fresh-water snails. Some of them have lungs, and must come to the surface to breathe the oxygen in the air. Others have gills, which take in oxygen from the water.

Salt-water or marine snails are the largest group of snails. There are about 55,000 kinds. Some kinds live along the seashore. Some live on the ocean floor in the deepest parts of the ocean. Most marine snails have gills. Many of these snails have a shelly lid, called an *operculum*, which seals the animal in whenever it draws itself into its shell. People who collect shells prize the colorful shells of various salt-water snails.

Useful and Harmful Snails. Many snails are an important food for fish and birds. Many people consider the *Helix* garden snail, which is known as *escargot*, a great delicacy. The *turban snail* of Australia is used to make pearly shirt buttons.

Certain fresh-water snails of the tropics carry *schistosomiasis*, a disease that causes thousands of deaths each year. The *giant African snail* destroys flowers, vegetables, and young rubber plants. This large snail is 6 inches (15 centimeters) long. Native to Africa, it is now also found in Hawaii and the Miami area of Florida. Some kinds of *cone snails* of the Indian and southwest Pacific oceans have a poisonous stinger $\frac{1}{2}$ inch (13 millimeters) long. The poison is used to kill small fish, but it has also caused the death of several human beings. The sea snails that people eat can carry such diseases as typhoid fever and hepatitis, if they are taken from polluted water near sewers.

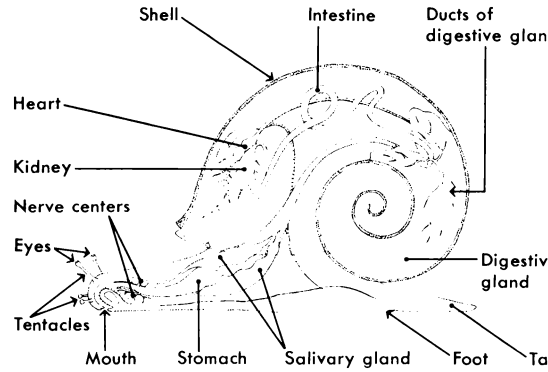
Scientific Classification. Snails belong to the class *Gastropoda*, in the phylum *Mollusca*. Snails with gills are members of the order *Prosobranchiata*. Those with lungs are in the order *Pulmonata*.

R. Tucker Abbott

Related Articles in World Book include:

Abalone	Limpet	Periwinkle	Slug
Conch	Mollusk	Schistosomiasis	Whelk
Cowrie	(Gastropods)	Shell, with pictures	

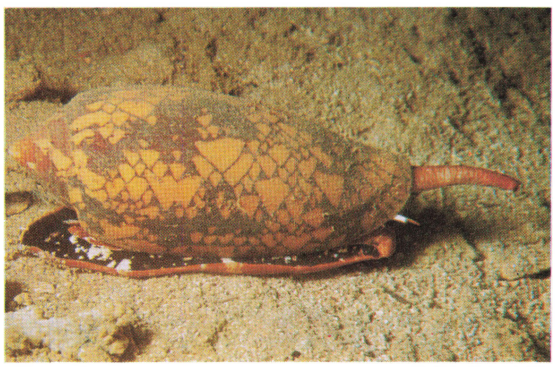
THE BODY OF A SNAIL



WORLD BOOK diagram by Marion Pahl

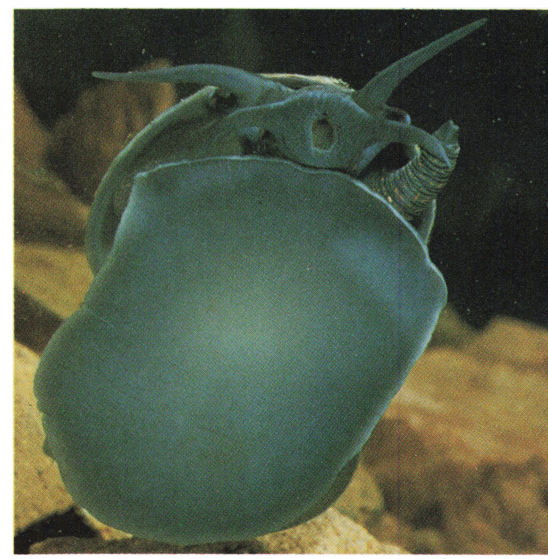
Lois Cox

A Land Snail lays a cluster of small, rubbery eggs in a damp place, such as a shallow hole in moist ground.



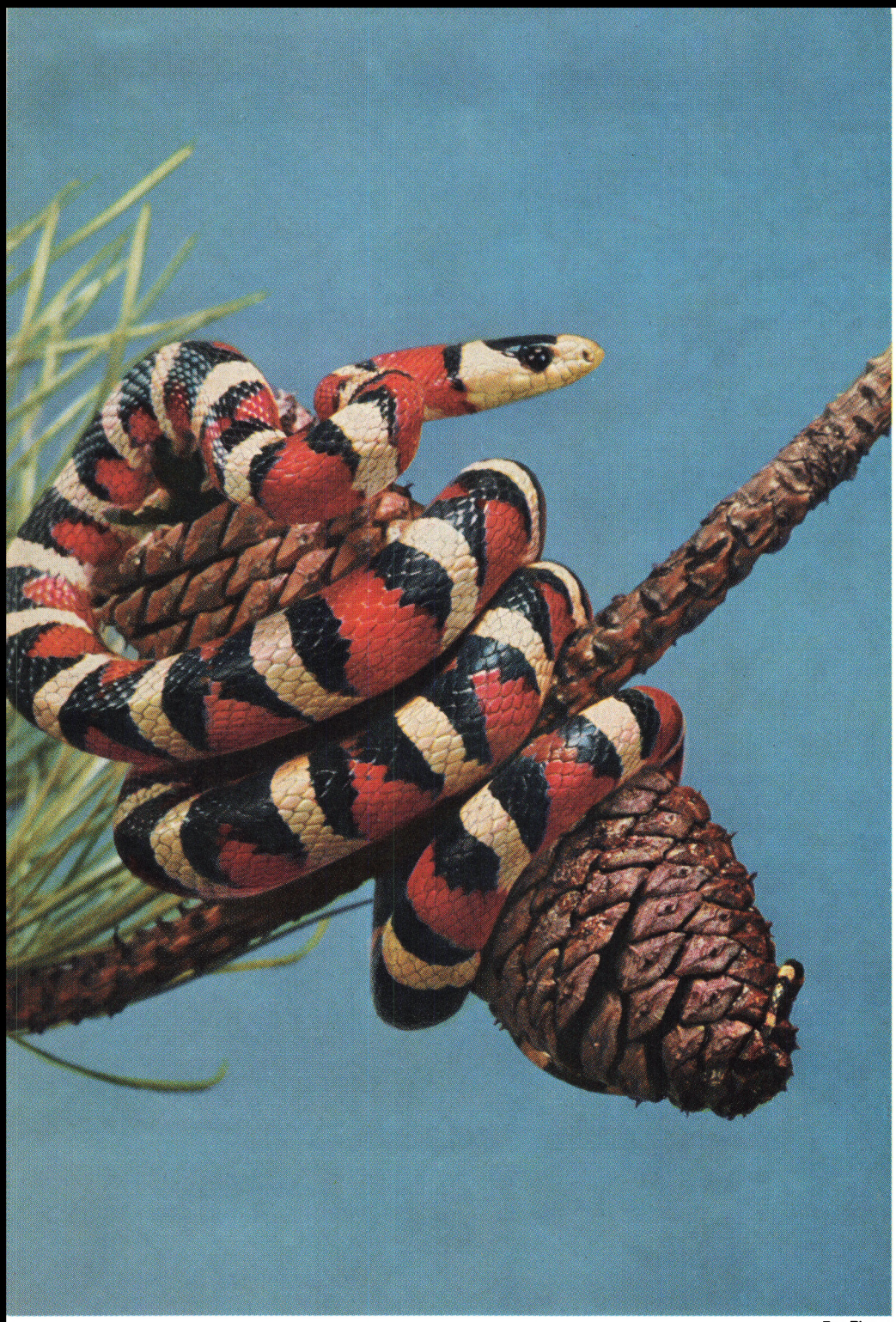
P. Laboute, Jacana

Cone Snails live in the Indian and southwest Pacific oceans. They feed on small sea animals, which they paralyze with a poisonous sting. Human beings have died from cone snail stings.



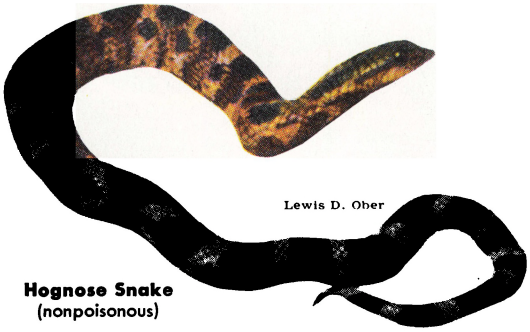
Grant Heilman from Runk/Schoenberger

The Foot and Mouth of a Mystery Snail can be seen clearly as this fresh-water creature clings to the side of a glass aquarium. Snails crawl by moving their foot muscles in a wavelike motion.



Roy Pinney

The Sonora Mountain King Snake forms a colorful pattern as it coils around a pine cone. This snake looks like the poisonous coral snake, but it is harmless.



Lewis D. Ober

Hognose Snake (nonpoisonous)

Snake

SNAKE is a legless animal that crawls. Many persons fear snakes. But this fact only makes snakes more interesting to persons who have either never had this fear or who have overcome it.

The snakes are the best-known legless reptiles. They form a large division of reptiles, rivaled in size only by the lizards. Their other relatives are the turtles, tortoises, alligators, crocodiles, and the tuatara.

More snakes live in the tropics than anywhere else, and that is where the largest ones are. The giant anaconda of South America and the reticulate python of Asia may grow to be 30 feet (9 meters) long. But there are very small snakes, not over 5 inches (13 centimeters) long, and others of various sizes. There are no snakes in New Zealand, the Azores, or Ireland, and there are few on most remote islands in the ocean.

Appearance and Habits

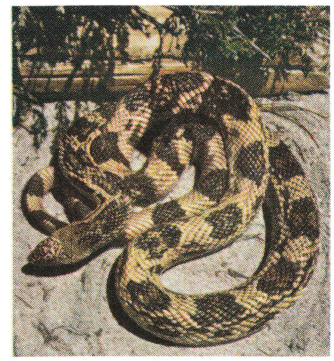
Many persons group snakes, earthworms, and eels together in their minds. About the only things these animals have in common are their shape and cold-bloodedness. The snake is not slimy like the worm and eel, but dry and smooth. It is covered with scales (see SCALE). The snake is deaf to sound carried by air. It hears by sensing vibrations from the ground. A snake's eyes are protected by a transparent cap that is shed with the skin. This cap keeps a snake's eyes always open, which makes it difficult to prove scientifically that a snake sleeps.

A snake's tongue is long, slender, and forked. The popular belief that a snake can sting with its tongue is untrue. Actually, the tongue is harmless. A snake keeps flicking out its tongue while moving along the ground, because it is the snake's organ of touch. A snake also uses its tongue to pick up particles and put them into two tiny cavities in the roof of its mouth. The cavities, known as *Jacobson's organ*, are linked with the snake's sense of smell. By picking up the particles, the tongue helps the snake to smell.

The snake has a backbone, like the eel. The snake's backbone is a very long chain of as many as 300 small bones, or vertebrae. A man has only 33 or 34 vertebrae.

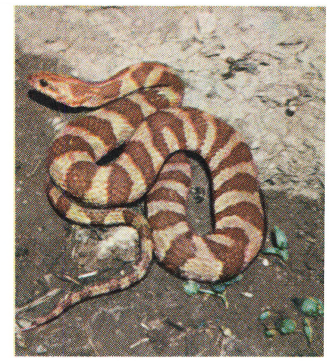
Hal H. Harrison

Eastern Ribbon Snake (nonpoisonous)



C. J. Stine

Pine Snake (nonpoisonous)
(eastern form of bull snake)



P. W. Smith

Banded Water Snake
(nonpoisonous)

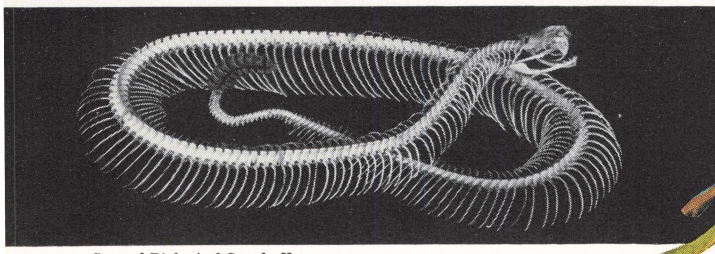
Cy LaTour

Emerald Tree Boa (nonpoisonous)

Corn Snake (nonpoisonous)

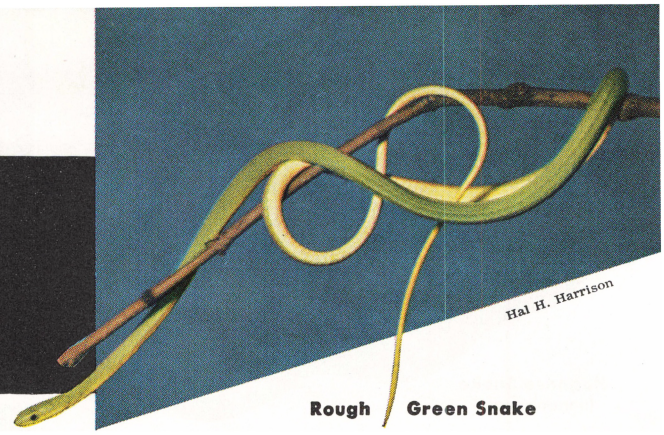
Roy Pinney

FACTS ABOUT SNAKES



General Biological Supply House

Rattlesnake Skeleton



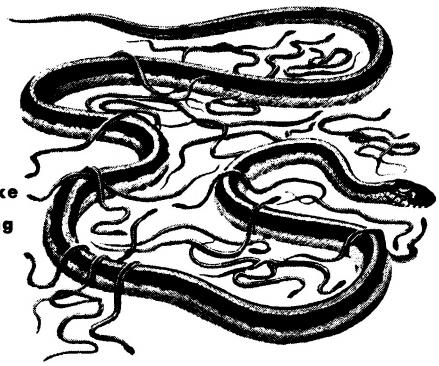
Hal H. Harrison

Rough Green Snake

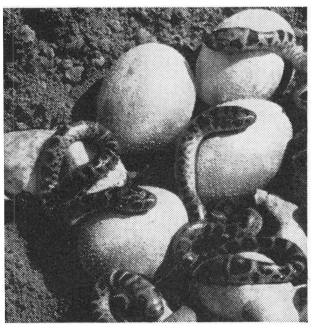
Indigo Snake

The Backbone of a Snake, *left,* may have 300 bones, or vertebrae. This flexible backbone makes it possible for a legless snake to crawl by wriggling its body, *right.* Most snakes travel very slowly, but some can go as fast as 3 miles (4.8 kilometers) per hour.

Tongue. A snake uses its forked tongue to touch or feel objects.



Garter Snake and Young



Lynwood M. Chace

Birth of a Snake. Most newly born snakes hatch from eggs, but some are born alive. The average female produces about 10 offspring at a time. But the python may lay as many as 100 eggs. The garter snake usually gives live birth to a brood of 20 or more.

Baby Blacksnakes and eggs

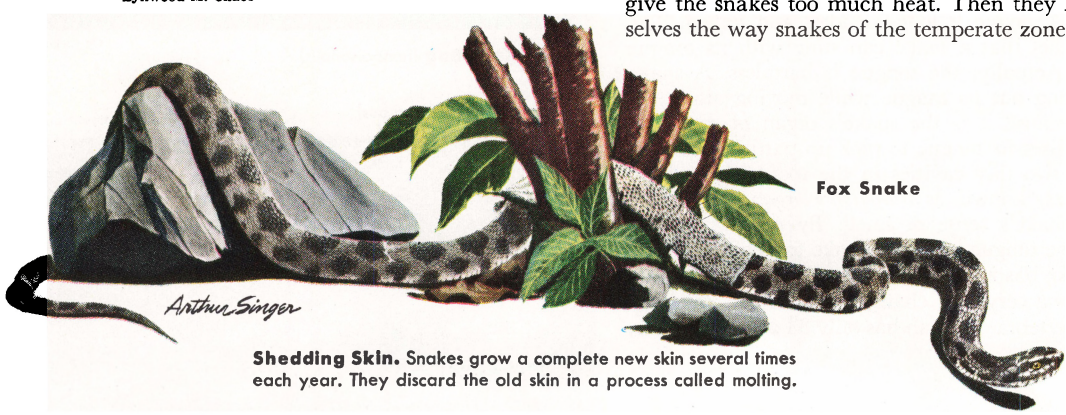
With this long string of bones, the snake can crawl, climb, and swim. The snake can bend easily because it has so many joints.

A person can tell the number of vertebrae in a snake's body if he counts the scales across the belly. There is about one scale for each vertebra, with its pair of ribs.

It is hard for a snake to crawl on a smooth, flat surface. Each curve of its body must have something on the ground to push against. When the curves all push at the right time, the snake can crawl with a rapid and beautiful motion. When it moves, it does not raise its body off the ground, but only bends it from side to side.

Snakes are cold-blooded, like all other animals except mammals and birds. This is the reason they feel cool to the touch. A man's body is always warm, but a snake's body is always about the same temperature as its surroundings. A snake taking a sun bath feels warm because its body takes up heat. Snakes and men can stand about the same degree of fever. But a snake can stand much greater chill. It does not die until its temperature goes below the freezing point.

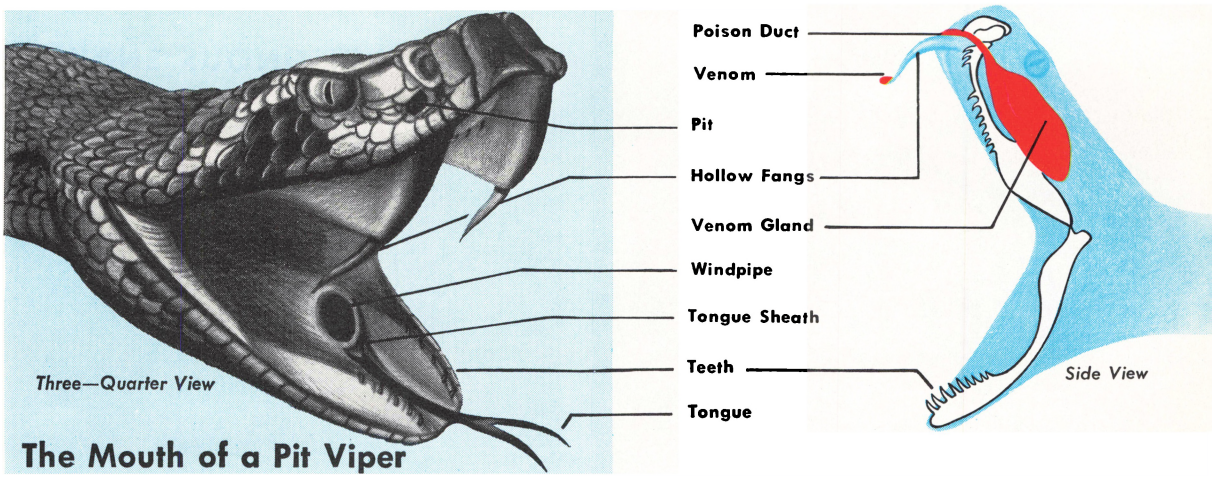
Snakes thrive in the tropics, like other animals that cannot control their own temperature. They have great trouble avoiding the severe cold of winter, and there are almost no snakes in the Arctic regions. In temperate zones, they pass the winter deep in the ground, or in some other place where it is warm enough. This way of spending the winter is called *hibernation.* The dense foliage of the tropics usually gives them enough protection from the sun. Very dry spells in some regions give the snakes too much heat. Then they hide themselves the way snakes of the temperate zones do in the



Fox Snake

Arthur Singer

Shedding Skin. Snakes grow a complete new skin several times each year. They discard the old skin in a process called molting.



The Mouth of a Pit Viper

winter. A snake hibernates in winter, and, when necessary, *estivates*, or passes the summer in inactivity.

It is not unusual to find almost perfect snakeskins in rocky or bushy places. Snakes grow a complete new skin several times a year. They slip out of the old one, turning it inside out, and leave it behind like a tube. This process is called *molting*. See MOLTING (picture).

One of the more remarkable actions of a snake is the way that it feeds. It must swallow its food whole because its teeth are sharp like needles, and not good for chewing. They are curved toward the throat to give a better grip, and help make up for the lack of legs. The bones of a snake's lower jaw are loosely connected to each other and to the skull. The snake can separate them and swallow an animal two or three times as thick as its head. Its powerful stomach juices then digest all the animal except feathers and hairs.

A healthy snake can do without food for a year or more. But snakes usually eat regularly and often, storing up extra food as fat. Since the snake can swallow large objects, it can eat many kinds of animals. The big pythons sometimes eat mammals weighing more than 100 pounds (45 kilograms). Animals with long bodies are the easiest to swallow. Lizards and other snakes are favorite foods of snakes. This does not mean that snakes eat their own kind. Zoologists say different kinds of snakes are no more closely related to each other than men are to the cows they eat. Some tropical snakes as small as worms eat tiny insects with soft bodies.

Most snakes hatch from eggs outside the mother's body. But some snakes develop inside the mother's body before birth. In either case, the young snakes

Reticulate Python

The Length of Snakes varies greatly. The reticulate python of Asia, *above*, and the anaconda of South America are the longest snakes. Both may grow as long as 30 feet (9 meters), about the length of six bicycles placed end to end.

E. R. Degginger

Baby Milk Snake

Lewis D. Ober

Eastern Diamondback Rattlesnake

Hal H. Harrison

Timber Rattlesnake

can take care of themselves. They can live without food for months if they have to. The number of young in a brood is different for different kinds of snakes. Some kinds have only a few at a time, whereas many others have dozens and a few even have scores.

Growth of Snakes

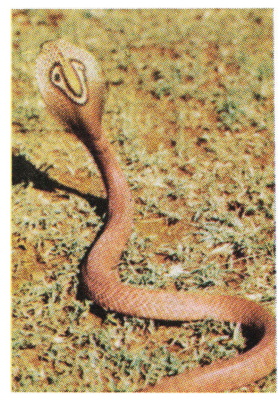
Zoologists have found it difficult to learn about the growth of snakes, because they can be studied only in captivity. The kinds of snakes that have been studied grow quickly, and reach maturity in about two years. Common snakes, such as the garter snake, are about 6 inches (15 centimeters) long at birth. At maturity, they measure about 18 inches (46 centimeters). The reticulate python, one of the largest snakes, is about 3 feet (91 centimeters) long at birth. When fully-grown, it may be some 30 feet (9 meters) long, and weigh about 200 pounds (91 kilograms). Scientists believe that most snakes live for a period of from 20 to 30 years. See LIFE (table, Length).

Poisonous Snakes

In most cases there is little reason to fear snakes. About 2,400 kinds of snakes are known, but only about 8 out of 100 are dangerous to man. Many places are entirely free of poisonous snakes. Some snakes are helpful. They kill many rats, mice, and other rodents that destroy crops.

Poisonous snakes are easy to recognize in the United States. Here, every poisonous snake is either a pit viper or a coral snake. Pit vipers have a deep hollow, or pit, in front of each eye and below it, on the side of the head. Rattlesnakes are pit vipers and are easy to know by their rattles. The only other pit vipers are the water moccasin and the copperhead.

POISONOUS SNAKES IN OTHER LANDS



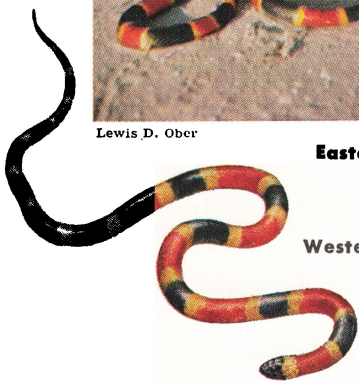
Ylla, Rapho Guillumette

Indian Cobra has a pattern on the back of its hood, or flattened neck. The pattern looks like eyeglasses. In preparing to strike an enemy, cobras rear up without looping their bodies. Fully-grown Indian cobras are nearly 6 feet (2 meters) long.

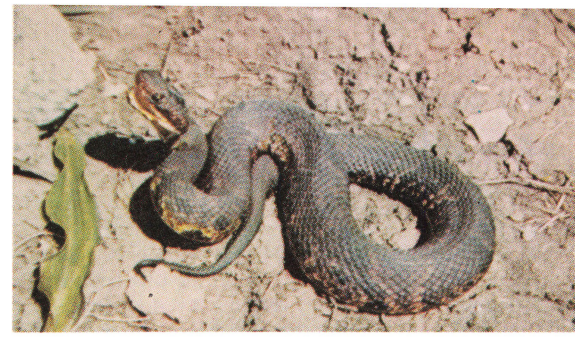
Indian Snake Charmer may fool his audience, but he does not charm the snake. The cobra cannot hear the music of the flute. It sways merely to follow the movements of the charmer.

Lewis D. Ober

Eastern Coral Snake



Western Coral Snake



P. W. Smith

Water Moccasin or Cottonmouth

Copperhead
Hal H. Harrison

Coral snakes have bright bands of red, yellow, and black. They live in tropical South America and in some warm regions of the United States and Mexico. Some harmless snakes look much like coral snakes. Two facts will help to identify them. In coral snakes, the snout is usually black, and the red and yellow bands are next to each other. In harmless snakes, the snout is red, and the red and yellow bands are separated.

Scientific Classification. Snakes belong to the class *Reptilia*. Many scientists group them together with the lizards, in the order *Squamata*, and call them the suborder *Serpentes* (formerly *Ophidia*).

CLIFFORD H. POPE

Related Articles in WORLD BOOK include:

KINDS OF SNAKES

Adder	Asp	Boa Constrictor
Anaconda	Blacksnake	Bushmaster
Cobra	Garter Snake	Python
Copperhead	King Snake	Rattlesnake
Coral Snake	Mamba	Viper
Fer-de-Lance	Milk Snake	Water Moccasin

OTHER RELATED ARTICLES

Brazil (Health and Science) Snake Bite Snake Charming

Outline

I. Appearance and Habits
II. Growth of Snakes
III. Poisonous Snakes

Questions

How does the snake use its tongue?
Why does a snake move so easily?
What kinds of poisonous snakes live in the U.S.?
Why are there only a few snakes in the arctic regions?
How do snakes help man?

Fer-de-Lance
(Latin America)

Gates Priest

Gaboon Viper
(Africa)

J. C. Couffer

Yellow-and-Black Sea Snake
(Warm parts of the Pacific and Indian oceans)

SNAKE BITE. The fangs of a rattlesnake or copperhead snake are like hollow hypodermic needles, which inject poison into the victim's body. The bite of a poisonous snake can be recognized by one or more punctures caused by the fangs. The poison quickly causes severe stinging. Soon the area around the bite begins to swell and turn purple. The victim may then become pale, weak, and sick at the stomach. His pulse becomes weak and rapid.

The coral snake leaves a different bite. It does not strike, but hangs on and chews. There is little pain at first, but later the breathing organs are partly paralyzed, and the patient becomes sleepy.

If the snake is not poisonous it leaves only a group of surface bites, sometimes shaped like a horseshoe.

If possible, the first thing to do in case of snake bite is to call a doctor. If the doctor's office or a hospital is near, take the patient there. Keep him motionless and quiet because activity increases the rate at which the poison spreads. Also, place the bitten portion of the body at a level below that of the heart.

If there is no doctor near, use first aid. Although some first-aid kits contain snake-bite serums, these *must not* be used without a physician's advice. First-aid measures for snake bite include the following:

1. Apply a band above the wound. The band should fit snugly, but should not be so tight as to cut off the blood flow through the arteries.

2. Paint the wound with iodine or alcohol. Sterilize a knife or razor blade (this can be done with a flame). Then make a single cut, parallel to the limb, at each fang mark and over the area where the venom appears most concentrated.

3. Apply suction to the cuts to remove the venom. Many first-aid kits contain a suction syringe. If none is available, suck the wound by mouth and spit out the venom. Be sure you have no open sores or cuts in your mouth. Apply suction for 30 to 60 minutes. If the poison spreads, another band should be placed on the limb, at a point above the first band.

4. Wash and dress the wound. The victim may drink water, unless he becomes nauseous or vomits. Do *not* give the victim whiskey or any other form of alcohol.

5. *Above all else*, get the victim to a doctor as soon as possible.

SNAKE CHARMING is an ancient form of entertainment in northern Africa, and in India, Pakistan, and other parts of southern Asia. A charmer usually uses a cobra in his act. He sits before the snake, playing a flute-like instrument and swaying to and fro. The cobra slowly raises its head and neck and follows the charmer's swaying movements to stay in front of him. The music has nothing to do with charming the snake. The snake has no external ears or eardrums, and cannot hear sound waves in the air. The snake is fascinated by the charmer's rhythmic movements. A snake charmer must understand the habits of his snakes. Snake charmers sometimes cut out the fangs of poisonous snakes to make them harmless. Some circuses have "charmers" who handle harmless boas or pythons. CLIFFORD H. POPE

SNAKE DANCE is a sacred ceremony of the Hopi Indians of northeastern Arizona. The Indians dance and pray for rain and good crops. The snake dance is held each August, and lasts nine days. Near the end of the ceremony, Indians called Snake priests dance with live rattlesnakes in their mouths. As far as is known, no Snake priest has ever been killed while handling the rattlesnakes. Some persons believe the snakes' fangs are taken out or the snakes' *venom* (poison) is removed before the public dance begins. JOHN C. EWERS

SNAKE KILLER. See ROAD RUNNER.

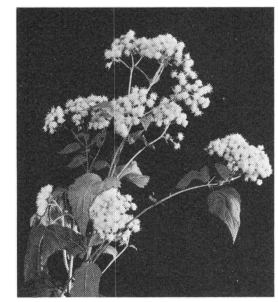
SNAKE RIVER is the chief branch of the Columbia River. It rises in Wyoming near the Continental Divide in Yellowstone National Park. It then flows south through Grand Teton National Park. Near southern Idaho, it bends westward and enters the Snake River Plains. Irrigation projects, dams, and falls provide water for power and irrigation for the cities and potato fields of the plains. For the location of the Snake River, see IDAHO (physical map).

The Snake River turns northward at the Oregon border, and forms part of the boundary between Idaho and Oregon. For about 40 miles (64 kilometers), the Snake flows through Hells Canyon. Parts of the canyon are deeper than the Grand Canyon. At Lewiston, Ida., the Snake turns westward and flows through southeastern Washington. Boats sail the Snake and Columbia rivers inland as far as Lewiston. The Snake joins the Columbia near Pasco, Wash., 1,038 miles (1,670 kilometers) from its source. JOHN H. GARLAND

See also IDAHO (Rivers); LEWISTON (picture).

SNAKEBIRD. See DARTER; WRYNECK.

SNAKEROOT is the name given to a large number of plants whose roots look like snakes. The plants grow throughout the United States and in many parts of Canada. Some kinds have medicinal value. *Black snakeroot*, or *cohosh*, yields a drug used to treat St. Vitus's dance. The roots of *Virginia snakeroot*, or *birthwort*, have tonic properties. *Canada snakeroot*, or *wild ginger*, has stimulating qualities. An emetic is prepared from *senega snakeroot*. Reserpine, sometimes used to treat high blood pressure, is made from *Rauwolfia*, a snakeroot (see RAUWOLFIA SERPENTINA).



N.Y. Botanical Garden

Snakeroot

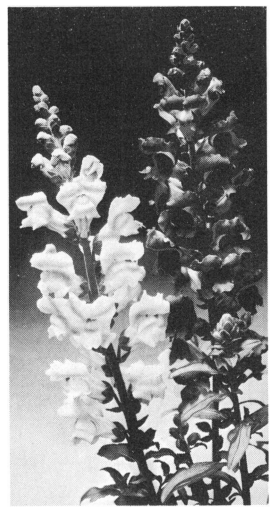
Scientific Classification. Black snakeroot belongs to the crowfoot family, *Ranunculaceae*. It is genus *Cimicifuga*, species *C. racemosa*. Virginia snakeroot and Canada snakeroot belong to the birthwort family, *Aristolochiaceae*. Virginia snakeroot is genus *Aristolochia*, species *A. serpentaria*. Canada snakeroot is genus *Asarum*, species *A. canadense*. Senega snakeroot is in the milkwort family, *Polygalaceae*. It is genus *Polygala*, species *P. senega*. White snakeroot: composite family, *Compositae;* genus *Eupatorium*, species *E. rugosum*. HAROLD NORMAN MOLDENKE

SNAPDRAGON is a group of hardy, colorful plants with flowers that look like an animal's head. Each blossom has two lips. The lips open like jaws when the sides of the blossom are pressed. When the pressure is released, the lips snap shut. The velvety flowers come in many colors. Tall varieties often grow 4 feet (1.2 meters) high. Dwarf varieties may reach 9 inches (23

centimeters). The best varieties of snapdragons resist *rust*, a plant-killing disease caused by a virus.

The *common snapdragon* is a popular garden flower. It must usually be grown from seeds each year, but sometimes lives through the winter.

Scientific Classification. Snapdragons belong to the figwort family, *Scrophulariaceae*. They make up the genus *Antirrhinum*. The common snapdragon is *A. majus*. H. D. HARRINGTON



Ferry-Morse Seed Co.

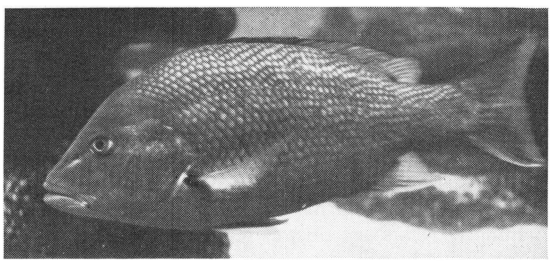
The Snapdragon is a favorite flower of children, who enjoy snapping the blossoms open by gentle pressure.

See also FLOWER (color picture: Summer Garden Flowers); BEARDTONGUE.

SNAPHANCE. See PISTOL.

SNAPPER is one of the important food fishes of southern waters. It lives in both the Pacific and Atlantic. The snappers of the Western Hemisphere are most common around Florida, the West Indies and the shores of the Gulf of Mexico, and the Caribbean region. In the Pacific, they live chiefly around the tropical coral atolls and the East Indies and Philippines. They live rather close to shore, usually in rocky places.

The snapper grows as long as 2 or 3 feet (61 to 91 centimeters). It has a high, almost humped, back, and is rather flat from side to side. The mouth is large, with strong teeth. Its tail is slightly forked. Snappers may be red, greenish, or striped. They often have a black spot on each side of their bodies.



Marine Studios, Marineland, Florida

Caribbean Red Snappers rank among the tastiest and most important food fishes caught off the coast of Florida.

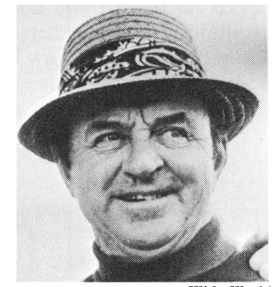
Scientific Classification. The snappers make up the snapper family, *Lutianidae*. The Caribbean red snapper is genus *Lutianus*, species *L. blackfordi*. LEONARD P. SCHULTZ

SNARE FISHING. See FISHING INDUSTRY (Snaring).

SNCC. See STUDENT NATIONAL COORDINATING COMMITTEE.

SNEAD, SAM (1912-), an American golfer, has won more major tournaments than any other person. During more than 30 years as one of the world's top golfers, Snead has won over 100 tourneys.

Snead won the Professional Golfers' Association (PGA) championship in 1942, 1949, and 1951, and the Masters tournament in 1949, 1952, and 1954. He won the British Open in 1946. The United States Open is the only major tourney that Snead has not won. He has finished second in that event four times.



Wide World

Sam Snead

Snead, who became known as "Slammin' Sam," won fame for his powerful drives and smooth, natural swing. He started playing golf professionally in 1935 and won his first major PGA tournament in 1937. Samuel Jackson Snead was born in Ashwood, Va., near Hot Springs. FRANK LITSKY

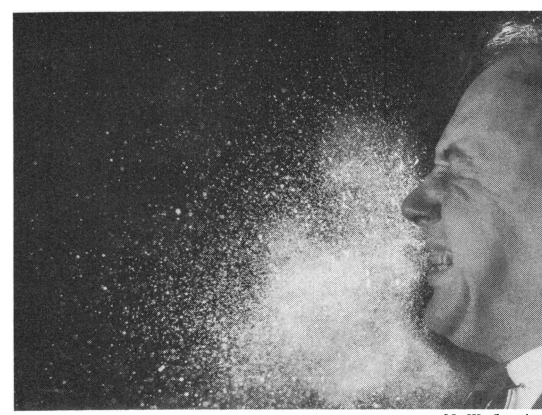
SNEEZEWORT is a hardy perennial plant that grows in damp fields and along roadsides in Europe, Asia, and North America. It is called sneezewort because its strong odor causes some people to sneeze. The plant grows from 1 to 2 feet (30 to 61 centimeters) high. It has loose clusters of small white flowers.

Scientific Classification. The sneezewort belongs to the composite family, *Compositae*. It is classified as genus *Achillea*, species *A. ptarmica*. ROBERT W. HOSHAW

SNEEZING is a sudden and violent rush of air out through the nose and mouth. A person has no control over sneezing. The body takes this action to get rid of irritating or harmful objects in the nose. Sensitive nerve endings that line the nose react to these objects by causing the sneeze.

Sneezing occurs often in an ailment called *hay fever*. Plant pollen lodges in the nose of sufferers and causes the sneeze. Bright sunlight can also cause sneezing because the eye nerves are closely connected with nerve endings in the nose.

Sneezing aids the body, but can be harmful to other persons. For example, a person's nose fills with congestion that contains germs when he has a cold. Sneezing helps clear the nose. But unless the sneezer



M. W. Jennison

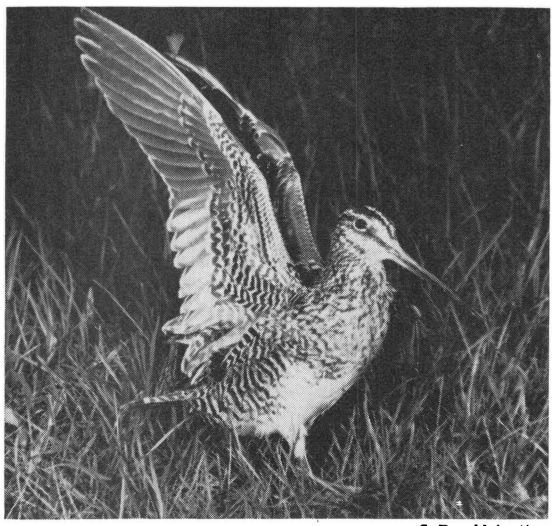
High-Speed Photograph of a Sneeze shows how the thousands of droplets are violently ejected from the nose and mouth.

covers his mouth and nose, the germs escape into the air and may infect others. ALBERT P. SELTZER

See also DISEASE (How Diseases Spread); COLD, COMMON; NOSE; HAY FEVER.

SNELLING, JOSIAH. See MINNESOTA (History).

SNICK. See STUDENT NATIONAL COORDINATING COMMITTEE.



G. Ronald Austing

Wilson's Snipe is called the jacksnipe by sportsmen. Because it lives in bogs, and is a fast flier, it is a difficult bird to shoot.

SNIPE is the name of a group of shore birds related to sandpipers, curlews, and plovers. The common snipe, also called *Wilson's snipe*, is about 11 inches (28 centimeters) long. It has a short tail and a long bill. It uses the flexible, sensitive tip of its bill to poke about for worms and grubs. This bird performs acrobatics in the air during the mating season. It also makes a strange "bleating" or "drumming" sound by flying to great heights and descending in a series of quick swoops as air rushes through its feathers. Wilson's snipe spends its summers from the northern United States to Hudson Bay and Labrador. It winters from Illinois and South Carolina southward. The snipe is more timid than the sandpiper about being seen in the open by day. It nests in low places in the ground on the edge of marshes. The female lays four olive brown or grayish drab eggs thickly spotted with chocolate color.

Scientific Classification. The snipe belongs to the sandpiper family, *Scolopacidae*. Wilson's snipe is genus *Capella*, species *C. gallinago*, subspecies *delicata;* European snipe is species *C. gallinago*, subspecies *gallinago*. ALFRED M. BAILEY

See also BIRD (How Birds Protect Themselves); CURLEW; YELLOWLEGS.

SNIPERSCOPE is an electronic infrared device that enables a person to see objects in the dark without the aid of visible light. It can be mounted on M1 and M14 rifles. The sniperscope consists of a telescopic image tube and an infrared source attached to the weapon. A small battery cartridge strapped to the person's belt provides power for the device. The sniperscope looks like a fog

Raytheon Co.

The Sniperscope enables a rifleman to see targets in the dark. It is powered by an electric battery worn at the shooter's waist.

light with a glass face painted black. Troops equipped with sniperscopes can fight effectively in the dark. They first used the instruments during World War II (1939-1945).

The sniperscope depends upon the reflection of invisible infrared rays from the object being viewed. The infrared source sends out rays that are reflected by objects in their path. The telescopic image tube picks up the reflected infrared image and converts it into a visible one.

SNOOKER. See BILLIARDS.

SNORING, *SNOHR ing*, is a rough, broken sound made during sleep. Almost everyone snores occasionally, but men usually snore more often than women and children. Snoring takes place when a sleeper breathes through his mouth. Air rushing out through the mouth vibrates the *soft palate*, the soft tissue in the roof of the mouth near the throat. This vibration produces the sound. As the soft palate vibrates, the lips and other mouth tissue, cheeks, and nostrils also may vibrate. The rushing air dries the soft mouth tissues, causing them to vibrate faster. This makes the snoring louder.

Many remedies have been tried to stop snoring. Bandages have been tied around the chin to the top of the sleeper's head so that his mouth would remain closed. A hundred years ago doctors removed the *uvula*, a tab of soft tissue hanging from the roof of the mouth near the throat. Attendants at an English hospital even tried dropping tiny soap pellets into a snorer's mouth whenever he made the sound. But doctors have never discovered a sure way to prevent snoring. ALBERT P. SELTZER

SNORKEL. See SKIN DIVING; SUBMARINE (Power).

SNORRI STURLUSON (1179-1241) was a great medieval Icelandic poet and historian. His major work was the *Heimskringla*, a history of the kings of Norway up to his time. He probably also wrote *The Saga of Egill Skallagrimsson*, one of the best Icelandic sagas about a great poet of the 900's who was one of Snorri's forefathers. Snorri wrote an *Edda* as a textbook to instruct the young poets of his day in *skaldic* poetry. Snorri was a wealthy and powerful man in Iceland. He became involved in a power struggle in Norway between Hákon Hákonsson and Skule Bardsson. Snorri supported Skule, who was defeated by Hákon. Snorri disobeyed Hákon's orders not to leave Norway in 1240, and Hákon ordered him killed in Iceland. KENNETH G. CHAPMAN

See also EDDA.

SNOW is the name for the shimmering ice crystals that form when the water vapor in clouds freezes. If the falling snowflakes pass through warm air, they melt and appear as raindrops. But if the falling snowflakes come in contact with cold raindrops at a temperature below 32° F. (0° C), the *supercooled* raindrops instantly freeze over the snowflakes. They form small bits of ice called *sleet*. This form of snow occurs when the air has vertical currents. The currents hold the snowflakes in the air until the sleet forms. If the currents are especially strong, *hail* may form. Sleet and hail need a strong vertical air current to keep them in the air until they form.

Many people have never seen snow, because it falls on only about a third of the earth's surface. In the polar regions, it falls in all seasons. In the temperate zone, it falls in winter. The heaviest snowfalls occur in the mountainous areas of the temperate zone, such as the Rocky Mountains and the Sierra Nevada range in the United States, and the Alps in Italy and Switzerland.

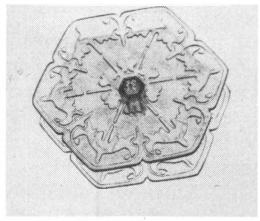
Properties of Snow. Snow always appears as tiny six-sided crystals. But no two snow crystals are exactly alike. Sometimes the crystals are flat. At other times they form long needles. Snow crystals often cling together to form snow pellets over 1 inch (2.5 centimeters) thick.

When mountain snow melts, it provides water for streams, electric-power plants, and irrigation reservoirs. There is much less water in snow than in rain. It takes a 6-inch (15-centimeter) layer of moist snow or a 30-inch (76-centimeter) layer of dry snow to equal the water in a 1-inch (2.5-centimeter) rainfall.

The tiny crystal surfaces of fresh snow reflect light and make the snow appear white. However, microscopic plants may change the color of snow after it has fallen. Greenland and other places in the Arctic sometimes have red and green snow on the ground.

Record Snowfalls. Weather records show that the average annual snowfall has remained about the same since the last half of the 1800's. In some years, it snows only a little, but in others it snows a great deal. Some persons believe that it snows less today than it did years ago. Yet new snowfall records are set almost every year. Single snowfalls of over 30 inches (76 centimeters) are not unusual in some places. On Jan. 26 and 27, 1967, 19.8 inches (50.3 centimeters) of snow buried Chicago, a record snowfall for that city. In February, 1969, Pinkham Notch, N.H., had a monthly snowfall of 130 inches (330 centimeters). In the hills southeast of Lake Erie and Lake Ontario, the average winter snowfall is over 150 inches (381 centimeters).

The United States record for snowfall in one season was set from July, 1970, to June, 1971, when 1,027 inches (2,609 centimeters) of snow was recorded at Rainier Paradise Ranger Station in Washington. In 1921, in Silver Lake, Colo., a 76-inch (193-centimeter) snowfall set a record for the largest snowfall during a 24-hour period. The greatest four-day snowfall occurred in Tahoe, Calif., which had 108 inches (274 centimeters) of snow from Jan. 12 to 15, 1952.



E. H. Reiber,
Buffalo Museum of Science

The Stud Snowflake comes from a great height. It is formed only in very cold temperatures. The model of this rare snowflake shows its two plates, which are arranged one above the other, and attached by a short column.

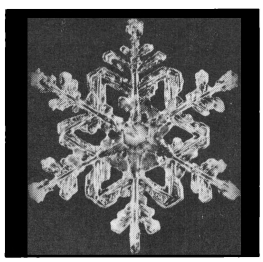
The record snowfall for a calendar month occurred in Tamarack, Calif., where 390 inches (991 centimeters) of snow fell in January, 1911. In the same year, a record depth of snow—454 inches (1,153 centimeters)—accumulated in Tamarack.

Artificial Snow. Man has produced artificial snow both in the laboratory and outdoors. In 1946, Vincent J. Schaefer of Schenectady, N.Y., produced the first artificial snow. The moist air of his breath condensed into supercooled water clouds when he breathed into a deep-freeze. He changed the clouds into snowflakes by inserting an extremely cold rod into the cloud. Since then, Schaefer and other research scientists have caused snow to fall from the water clouds in the sky by using various chemicals.

GEORGE F. TAYLOR

Related Articles in WORLD BOOK include:

Avalanche	Hail	Snow Blindness	Snowplow
Climate	Rainmaking	Snow Line	Snowshoe
Glacier	Sleet	Snowmobile	Weather



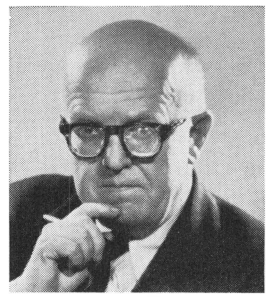
Snowflake Shapes are shown in "casts." The flake falls into a plastic solution which coats the snowflake and hardens quickly. As the flake melts, it leaves a hollow shell, or cast, which retains the exact shape of the flake.

Photomicrographs by
Vincent Schaefer

SNOW, C. P. (1905-), is an Englishman of many talents who is most famous as a novelist. He is also a scientist, government official, and lecturer.

Snow's 11-volume series of novels *Strangers and Brothers* (1940-1970) is a study of England's professional class. Lewis Eliot is an important character and the narrator in all the novels. Like Snow, Eliot is a man of lower class birth who works his way into professional life. Eliot appears in many jobs in the series, a device that allows Snow to present a panoramic view of English life. Eliot is a lawyer in *Strangers and Brothers* (1940) and *Time of Hope* (1949), a university teacher in *The Light and the Dark* (1947) and *The Masters* (1951), and a government official in *The New Men* (1954). In *The Sleep of Reason* (1968), Eliot serves as an observer at a sensational murder trial. Colorless, almost stodgy, Eliot is nevertheless an impartial, selfless man. To Snow, he is the kind of man needed to make responsible professional decisions.

Charles Percy Snow was born in Leicester and



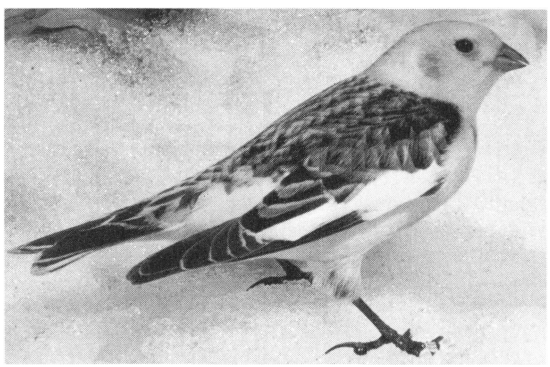
Pix from Publix

C. P. Snow

earned a doctor's degree in physics from Cambridge University. As a civil service commissioner from 1945 to 1960, he selected scientists for government projects. Snow was knighted in 1957. He was parliamentary secretary to the minister of technology from 1964 to 1966. In *The Two Cultures and the Scientific Revolution* (1960), a published lecture, Snow deplores the lack of communication and of understanding between scientists and nonscientists. FREDERICK R. KARL

SNOW BLINDNESS is a temporary loss of sight caused by bright sunlight reflected from snow. It usually lasts from several days to a week. Occasionally a person has trouble distinguishing between colors after snow blindness, and "sees red" for a long time. Snow blindness disappears when a person rests his eyes and remains indoors. Wearing dark-colored glasses helps avoid snow blindness. Eskimos living in Arctic areas avoid it by wearing gogglelike bone shields with long, narrow slits over their eyes. LOUIS D. BOSHES

SNOW BUNTING, or SNOWFLAKE, is a sparrowlike bird of northern North America. It is mostly white on its head and breast, but its back, wings, and tail are partially black. During the fall and winter, the head and back feathers are edged with brown. These edges wear off as the winter passes on. The bird turns black and white before it reaches its nesting ground on the tundra in Canada and Alaska. Snow buntings



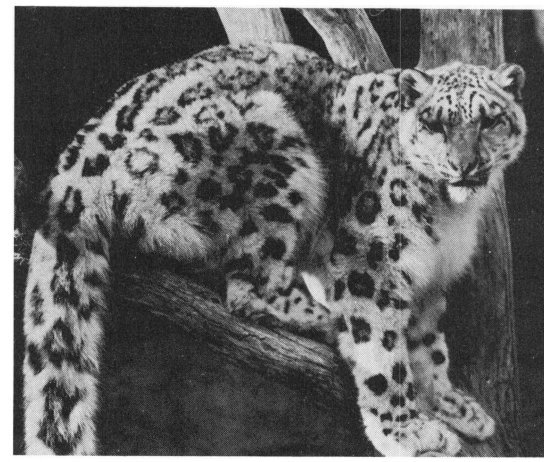
Mitchell Campbell, NAS

The Snow Bunting

are familiar winter birds in Canada. They come as far south as the United States only when the snow is heavy. They spend their summers in the Arctic regions.

Scientific Classification. The snow bunting belongs to the finch family, *Fringillidae*. It is genus *Plectrophenax*, species *P. nivalis*. LEONARD W. WING

SNOW LEOPARD, or OUNCE, is a beautiful member of the cat family. When full-grown, this animal is 6 to 6⅔ feet (1.8 to 2.03 meters) long. The snow leopard's summer home is as far up as 13,000 feet (3,960 meters) in the cold Tibetan plateau of central Asia, from the Altai Mountains south to the Himalayas. During the coldest winter months, the animal goes down into the valleys as low as 6,000 feet (1,800 meters). Its heavy hair is pale gray and marked with leopardlike brown spots. Its pale color helps it to steal unnoticed over the snow. In its native rocky home, the snow leopard feeds on ibex, bharal, marmots, pikas, and other animals. So many snow



James Purdue, NAS

The Snow Leopard, or Ounce, Has a Heavy Coat of Fur.

leopards have been killed for their fur that the species has become rare. See also ANIMAL (picture: Animals of the Mountains).

Scientific Classification. The snow leopard belongs to the cat family, *Felidae*. It is classified as genus *Uncia*, species *U. uncia*. ERNEST S. BOOTH

SNOW LINE is the lower edge of the permanent snow fields found on upper mountain slopes. The location of the snow line depends upon the height of the sun, winds, temperature, and moisture. The snow line on the same mountain range may change from year to year. In the tropics, the snow line is about 3 miles (4.8 kilometers) above sea level. The snow line of the Rocky Mountains is about 2 miles (3.2 kilometers) above sea level. In the Alps, the snow line is about 1⅔ mile (2.7 kilometers) above sea level. It is less than ½ mile (0.8 kilometer) above sea level in Greenland. It is at sea level in polar lands. SIGISMOND DER. DIETTRICH

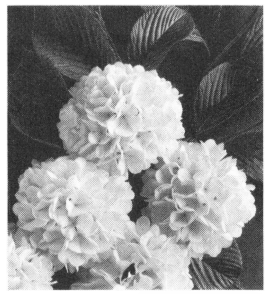
SNOW-ON-THE-MOUNTAIN is a popular garden plant grown for its attractive white flowers and white-edged upper leaves. It is found mostly in the western and midwestern parts of the United States. It must be replanted each year. The plant may grow to be 2 feet (61 centimeters) high. The flowers are small and shaped somewhat like umbrellas. Each flower is enclosed by white parts, known as bracts, that look like petals.

Scientific Classification. Snow-on-the-mountain belongs to the spurge family, *Euphorbiaceae*. It is genus *Euphorbia*, species *E. marginata*. MARCUS MAXON

SNOW PLANT. See FLOWER (color picture: Mountain Flowers [Bright-Red Snow Plants]).

SNOW REMOVAL. See ROADS AND HIGHWAYS (Clearing Ice and Snow); SNOWPLOW.

SNOWBALL, or GUELDER-ROSE, *GEL der ROHZ,* is a handsome shrub of the honeysuckle family which produces large, ball-shaped white flowers. The plant is believed to have originated in the Dutch province of Gelderland. The snowball is often grown in parks and lawns of the United States today. It is a cultivated form of high-bush cranberry, and grows from 7 to 12 feet (2.1 to 3.7 meters) high. The flowers of the cultivated species do not produce fruit, but a wild guelder-rose bears juicy, red berries. It is also called *European cranberry bush.*



J. Horace McFarland

The Snowball

Scientific Classification. The snowball is in the honeysuckle family, *Caprifoliaceae.* It is classified as genus *Viburnum,* species *V. opulus.* J. J. LEVISON

SNOWDON is the highest mountain in Wales. This peak rises to a height of 3,560 feet (1,085 meters) above sea level. The mountain is in Gwynedd, in northwest Wales. It is a background for many Welsh legends.

SNOWDROP is the name of a plant in the amaryllis family. It gets its name from its many delicate white blossoms which seem to be made out of snow. Snowdrops grow in many parts of the world. They bloom in March or April in northern countries. The snowdrop is one of the special flowers for the month of January.

J. Horace McFarland

The Snowdrop Is One of the First Heralds of Spring.

The plant grows from a small bulb which produces 2 or 3 narrow green leaves and a flower stalk without leaves. The nodding, bell-shaped flowers grow alone, one on top of each stalk. The *common snowdrop* of the gardens is one of the hardiest outdoor plants. It sometimes blooms in midwinter when a sudden warm spell causes the surface of the ground to thaw. In England, the people call the plant the *Fair Maid of February.* Snowdrops are easy to cultivate, for the bulbs can be planted in a sheltered place in early fall and left to themselves. They require little attention.

Scientific Classification. The common snowdrop belongs to the amaryllis family, *Amaryllidaceae.* It is genus *Galanthus,* species *G. nivalis.* ALFRED C. HOTTES

SNOWFLAKE. See SNOW; SNOW BUNTING; GORILLA (picture: The First Albino Gorilla Ever Exhibited).

SNOWMOBILE is a motorized sled that carries one or two persons over ice and snow. Snowmobiling is a popular winter sport in Canada and the northern United States. The first sled-sized snowmobiles built by mass production were made by Joseph-Armand Bombardier of Valcourt, Que., in the late 1950's.

Most snowmobiles measure from 5 to 8 feet (1.5 to 2.4 meters) long and about $2\frac{1}{2}$ feet (0.76 meter) wide. They ride on two short skis on the front of the vehicle, and a wide *track* (belt) toward the rear. An engine of from 8 to 60 horsepower (6 to 45 kilowatts) moves the track, propelling the snowmobile forward. The operator steers with handlebars. Most snowmobiles can go up to 50 miles (80 kilometers) per hour, and some more than twice that speed. Snowmobile operators should observe safe speeds and they should take other safety precautions. Careless snowmobiling has resulted in death and serious injury.

Many environmental groups criticize snowmobiling. They believe it destroys trees and shrubs and endangers wildlife. They also declare that the noise of snowmobile engines disturbs the peacefulness of rural areas. To deal with these objections, a number of states and provinces restrict snowmobiling to certain areas and enforce snowmobile speed limits and noise levels. In addition, manufacturers have produced quiet models that meet strict noise regulations. HERMAN WEISKOPF

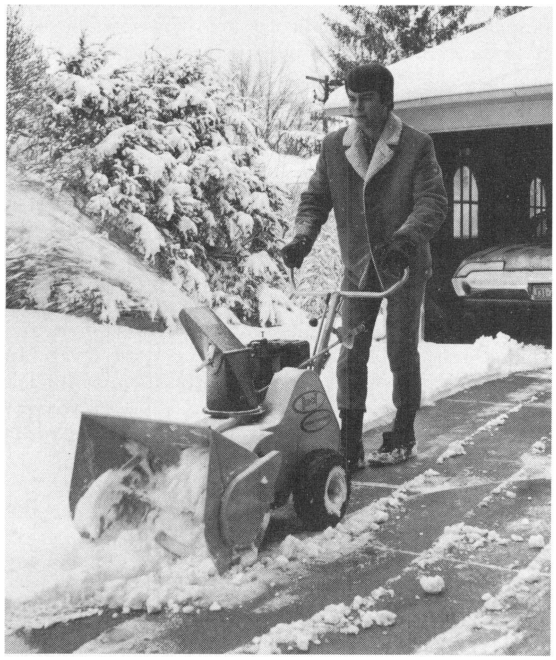
See also ESKIMO (picture: Speedy Snowmobiles); ROYAL CANADIAN MOUNTED POLICE (picture).

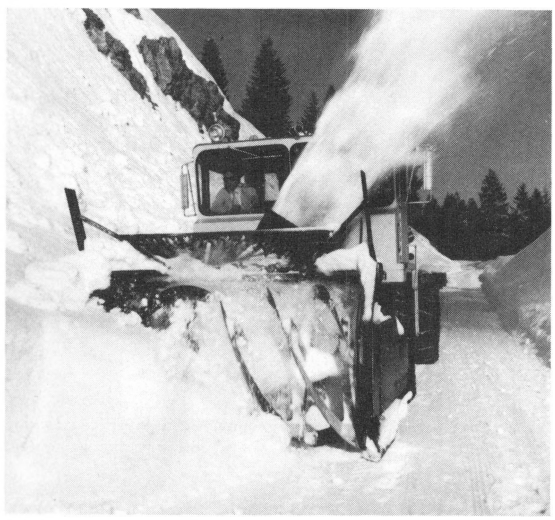
Evinrude Motors

Snowmobiles—motorized sleds—move easily over ice or snow. Snowmobile driving is a popular winter sport in northern climates.

SNOWPLOW is an implement used to clear snow from streets, highways, railroad tracks, and airport runways. A type commonly used to clear streets consists of a V-shaped metal blade mounted on the front of a truck or road grader. For light snows, trucks may be equipped with a single, horizontal curved blade that

throws the snow to one side. Rotary plows are used to clear deep snowdrifts. A common type of rotary plow consists of a horizontal, spiral rotor that resembles an auger. The rotor breaks up the snow and forces it to the center of the plow where a fan blows it out of a spout. Small rotary plows about the size of power lawn mowers have been developed for homeowners. Railroads often use powerful fan-type plows mounted on the front of locomotives. F. H. KELLOGG





Wisconsin Marine Co.; U.S. Dept. of Transportation

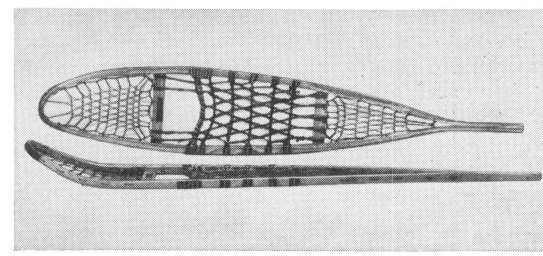
Snowplows use a motor's power to clear away snow. They eliminate the long, hard work involved in removing large amounts of snow with a shovel. A homeowner uses a small plow to clear his driveway, *top*. A state worker drives a huge plow to remove deep snow from a highway, *above*.

SNOWSHOE is a device that enables a person to walk over deep snow without sinking into it. This is possible because snowshoes distribute a person's weight over a large area. Most snowshoes are at least 3 feet (91 centimeters) long, and from 1 to $1\frac{1}{2}$ feet (30 to 46 centimeters) wide. They are made of a light wooden frame, bent into a long oval. Strings of animal hide are stretched across the frame.

In walking with snowshoes, the wearer moves his feet so that the snowshoes slide along the surface of the snow. He gives an outward motion to the snowshoes with each step.

Snowshoes were first used by the North American Indians. Today, they are used in regions of deep snow by hunters, trappers, loggers, and farmers. In some parts of Canada, there are snowshoe clubs organized for recreation. FRANKLIN M. RECK

See also INDIAN, AMERICAN (color picture: Snowshoes).



Snocraft

Snowshoes look like oddly shaped tennis rackets. They are made of strings of animal hide stretched over a wood frame.

SNOWSTORM. See BLIZZARD.

SNOWY EGRET. See EGRET with picture.

SNOWY MOUNTAINS SCHEME is a big irrigation and hydroelectric power project in southeastern Australia. Its generators provide electric power for the Australian Capital Territory and the states of New South Wales and Victoria. The dams store water from the Snowy River, on the southern slopes of the Snowy Mountains, and send it through the mountains to irrigate farmlands in the Murray and Murrumbidgee river valleys, north of the mountains. The project is one of the largest power and irrigation schemes in the world. It includes 17 large dams and several small ones, 9 power stations, about 100 miles (160 kilometers) of tunnels, 80 miles (130 kilometers) of aqueducts, and long stretches of high-voltage electricity transmission lines. Work on the project was completed in 1974.

SNOWY OWL. See OWL with picture.

SNUFF is a fine powder made from the stems and leaves of the tobacco plant. The tobacco is first fermented by heat and moisture, and then dried and ground. Snuff may be sniffed in through the nostrils, chewed, or rubbed on the gums. Various mixtures of flavors or scents are added to make the powder pleasant. At one time, each person carried a snuffbox and it was considered a matter of etiquette to offer a pinch of snuff upon meeting a friend. This practice is still carried on in southern Europe. The habit of taking snuff is considered harmful. It irritates the nerves of smell and lessens the ability to distinguish odors.